Appendix B

FOOTE MINERAL CO. SUPERFUND SITE

EAST WHITELAND, PENNSYLVANIA

RECORD of DECISION

RECORD OF DECISION
FOOTE MINERAL CO. SUPERFUND SITE

DECLARATION

Site Name and Location

Foote Mineral Co. Superfund Site
15 South Bacton Hill Road
East Whiteland Township, Chester County, Pennsylvania
CERCLIS ID number PAD077087989

Statement of Basis and Purpose

The attached Record of Decision ("ROD") presents the selected remedial action ("Remedy") for the Foote Mineral Co. Superfund Site ("Site") located in East Whiteland Township, Chester County, Pennsylvania. The Remedy was selected in accordance with the requirements of the Comprehensive Environmental Response, Compensation and Liability Act of 1980, 42 U.S.C. Sections 9601 - 9675, as amended ("CERCLA"), and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan ("NCP"), 40 C.F.R. Part 300. The ROD explains the factual and legal basis for selecting the Remedy for this Site. The information supporting the ROD is contained in the Administrative Record for this Site.

The Pennsylvania Department of Environmental Protection ("PADEP") concurs with the Remedy.

Assessment of the Site

Pursuant to delegated authority, I hereby determine, pursuant to Section 106 of CERCLA, 42 U.S.C. Section 9606, that actual or threatened releases of hazardous substances from this Site, if not addressed by implementing the response action selected in the ROD, may present an imminent and substantial endangerment to public health and the environment.

Description of the Remedy

The Remedy described here represents a comprehensive remedial response for this Site. The Site is surrounded by a mix of residential, agricultural and commercial properties. Chemical and mineral processing operations conducted at the Site have resulted in waste materials and contaminated soils, sediment and surface water located on the approximately 79 acre Foote Mineral Company property ("Property"). Contaminated materials on the Property, particularly the large volumes of waste in two on-site quarries, have contributed to contamination in the underlying groundwater. Site-related contamination has been found in groundwater extending more than 9,000 feet east northeast of the Property boundary. Also, six discrete areas on the

Property have been identified with radiation contaminated soils.

The Remedy addresses the threats from exposure to the waste materials and contaminants in the soils on the Property and in the downgradient groundwater. The major components of the Remedy include:

1) Excavation and off-site disposal of radiation contaminated soils at an appropriately permitted facility.

2) In-situ soil stabilization of the process tailing wastes located in the South Quarry.

3) Excavation and consolidation of contaminated soils, waste materials and debris into the North and South Quarries to prevent direct contact threats.

4) Capping of the North and South Quarries to contain and reduce contaminant migration from the waste in the Quarries to the groundwater.

5) Long-term monitoring of the Groundwater conducted to determine if the above source control measures are effective in reducing contaminant concentrations in groundwater to drinking water standards.

6) Removal of LNAPL from groundwater in MW-2 to prevent its migration into the groundwater.

7) Institutional controls shall be implemented to prevent residential use of impacted groundwater, to prevent residential use of the capped Quarry areas and to preserve the integrity of the remedy.

The Remedy will protect human health and the environment. Consolidation and capping of the wastes will minimize the sources of contamination that pose a direct contact threat or that can migrate to the underlying groundwater. Soils will be remediated to residential cleanup standards, allowing the future residential use of non-capped portions of the Site. Excavation and off-site disposal of the radiation contaminated soils will eliminate the potential for exposure to radioactive materials.

Statutory Determinations

The Remedy is protective of human health and the environment, complies with all Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, is cost-effective, and utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable.

The in-situ soil stabilization component of the Remedy satisfies the statutory preference for treatment as a principal element of the Remedy (i.e. reduces toxicity, mobility or volume of hazardous substances, pollutants or contaminants as a principal element through treatment).

The Remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unrestricted use and unrestricted exposure. Therefore an assessment of the Site will be conducted no less than every five years after initiation of remedial action in accordance with Section 121 (c) of CERCLA, 42 U.S.C. Section 9621(c), to ensure that the Remedy continues to provide adequate protection of human health and the environment.

ROD Data Certification Checklist

The following information is included in the Decision Summary of this ROD. Additional information can be found in the Administrative Record for this Site.

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3/21/06

Abraham Ferdas, Director
Hazardous Sites Cleanup Division
Region III

Date

FOOTE MINERAL CO. SUPERFUND SITE
EAST WHITELAND, PENNSYLVANIA

RECORD of DECISION

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FOOTE MINERAL CO. SUPERFUND SITE

DECISION SUMMARY

I. SITE NAME, LOCATION, AND DESCRIPTION

The Foote Mineral Co. Superfund Site ("Site") is comprised of the waste materials and contaminated soils, groundwater, surface water and sediment located on and extending from an approximately 79 acre property (the "Property") previously owned and operated by the Foote Mineral Company ("Foote Mineral"). The Property is located at 15 South Bacton Hill Road in East Whiteland Township, Chester County, Pennsylvania (Figure 1). Only the contaminated areas (collectively called the "source areas" and discussed in more detail later in this document) of the Property are included in the definition of the Site. The boundaries of the Site also extend further east than the legal boundaries of the Property since contamination has migrated eastward, away from the Property, in the groundwater. Site-related contamination has been found more than 9,000 feet east-northeast of the quarries located on the Property, and is estimated to reach approximately 10,000 feet beyond the Property boundary. This extended area of groundwater contamination is also part of the Site

The Property was the location of the former Foote Mineral Company's Frazer Facility, which was involved in the production of lithium chemicals and processing of a variety of ores. At the height of operations, the Property had 52 buildings and process areas. Figure 2 shows a diagram of the Property only; the entire Site, which includes part of the Property and the extended plume of groundwater contamination, is better represented by the area within the boundaries of the Area of Concern depicted in Figure 3. The facility closed in 1991, and the remaining buildings were demolished down to the foundation slabs in order to minimize the danger from the deteriorating structures.

The west side of the Property is undeveloped and has been used in the past for raising crops. Because contamination has not been found in this portion of the Property, it is not considered a part of the Site. The central portion of the Property, which was the Main Plant Area, is part of the Site and has contaminated soil and groundwater areas, as well as the foundations of the demolished buildings, the remains of roadways and a former wastewater equalization basin that still receives stormwater runoff and ultimately discharges to a local tributary via a drainage ditch. Currently in the Main Plant Area, work is being conducted by the Site owner to excavate and consolidate the remaining concrete from the foundations of the former process buildings. The consolidated materials are stockpiled on the Property and will be disposed in accordance with the remedy described in this Record of Decision (ROD).

There are two Quarries (the "North Quarry" and the "South Quarry") occupying the eastern portion of the Property that are partially filled with waste materials; these Quarries are also part of the Site. The North Quarry covers almost two acres and is a physical depression about 50 feet deeper than the surrounding area. The South Quarry covers nearly three acres and is also a depression with a surface that ranges from 8 to 26 feet below the surrounding ground level. When the South Quarry was originally excavated, it was much deeper than it appears now. The bottom of the quarry was originally excavated below the water table, so at times the bottom portion of the waste that was deposited in the South Quarry will be submerged and in direct contact with the groundwater. Contaminants that have been found in the soils and groundwater of the Property include lithium, boron, chromium, volatile organic compounds (VOCs) and other organic chemicals. Bromate has also been found in the groundwater beneath some of the Property, primarily in the area of the South Quarry.

II. SITE HISTORY AND ENFORCEMENT ACTIVITY

Site History

In 1932, and for some years prior, the northeastern portion of the Property was quarried for limestone. During quarrying operations, a limestone processing plant operated on the Property. Between 1941 and 1991, various owners and operators of the Foote facility used the Property for the production of lithium chemicals and the processing of a variety of ores. During World War II, a portion of the Property was nationalized and operated under the Defense Corporation of America for the production of lithium salts. At various times during operations at the Property, some of the production wastes were disposed of in the Quarries. Construction and demolition debris, municipal wastes and waste water were disposed of in the North Quarry. Spent mineral wastes and process waters were disposed of in the South Quarry.

Other areas of the Property used for disposal included three settling ponds which were used to remove magnetic iron from lepidolite ore, resulting in residual lithium contamination. Pyrophoric (extremely flammable) wastes were burned in a pit on the southwest portion of the Site. Burned wastes contained diethyl ether, n-hexane, n-pentene, benzene, tetrahydrofuran and methanol. An unlined pond on the northwest portion of the facility was utilized to wash production equipment. These areas were subsequently backfilled. Process water was also discharged, after treatment, through a permitted discharge to Valley Creek.

Over the years these operations generated large amounts of waste materials, some of which were disposed of on the Property resulting in:

- contamination in the two Quarries: the South Quarry contaminated with large amounts of lithium-containing process wastes and contaminated waste water, and the North Quarry contaminated with municipal waste, demolition debris, waste water and other process wastes contaminated with lithium;

- groundwater beneath the Property contaminated with boron, lithium, chromium, and bromate, and a limited area of the Property where groundwater is contaminated with organic chemicals, including benzene and tetrachloroethylene;

- public and private groundwater wells to the east of the Property contaminated with unacceptable levels of boron, lithium, chromium and bromate;

- areas of the Property where soil is contaminated with petroleum hydrocarbons and wastes from processing ores and minerals;

- runoff, caused by precipitation, carrying sediment into nearby surface water; and

- areas of soil contaminated with low-level radiation believed to be the residual from mineral ores.

The undeveloped western portion of the Property, including that portion of the Property located in West Whiteland, was reportedly not used for active plant operations or waste disposal. Analysis of the localized soils and the groundwater beneath this portion of the Property has confirmed this view; therefore the western portion of the Property is not considered part of the Superfund Site, as indicated by the portion of the Property not included in the Area of Concern in Figure 3.

Investigations and Regulatory Actions

During a routine inspection in 1969, the Pennsylvania Department of Environmental Resources (since renamed to the Pennsylvania Department of Environmental Protection and for this document referred to as PADEP) became aware of the facility's waste water discharge into the South Quarry. As a result, PADEP requested that Foote Mineral conduct initial monitoring of the groundwater beneath the Property, as well as the groundwater from nearby residential wells. In 1975, PADEP ordered Foote Mineral to discontinue burning wastes in the burn pit, stop discharging waste water to the South Quarry and initiate quarterly sampling of residential wells for lithium. In 1987, PADEP allowed Foote Mineral to reduce the frequency of the well monitoring to semi-annual sampling.

In 1973, at PADEP's request, Foote Mineral backfilled an old unused wash pond and in 1975 backfilled two other settling ponds that were used to collect impurities from the lepidolite crushing process. In 1979, Foote Mineral backfilled the solvent burn pit and mounded additional soil on top of the burn pit area.

After several follow-up investigations confirmed the presence of lithium and other contaminants in groundwater at the Site, PADEP requested assistance from EPA. On November 8, 1988, EPA completed an initial site investigation and, on June 29, 1990, entered into an Administrative Order on Consent pursuant to Section 1431(a)(1) of the Safe Drinking water Act, 42 U.S.C.

§300 i(a)(i), with Foote Mineral to conduct an extensive groundwater survey of the area, provide an alternate drinking water source to affected residents and conduct a five-year monitoring program to ensure the continued safety of private drinking water supplies. In 1991 Foote Mineral ceased all operations at the Frazer Facility.

After reviewing data gathered during PADEP and EPA site investigations, EPA added the Foote Mineral Site to the National Priorities List (NPL) in October 1992, making it eligible for cleanup under the Superfund program.

In 1992, contractors for Foote Mineral removed two underground storage tanks and excavated approximately 15,000 cubic yards of contaminated soil located beneath a leaking petroleum storage tank. The soil was piled onsite and treated using bioremediation, which uses biological organisms to destroy contaminants by breaking them down into non-toxic compounds. As part of the groundwater monitoring program, contractors for Foote Mineral routinely sampled nearby residential wells until 1995. During that time, sampling results did not indicate that the residents were exposed to unsafe drinking water.

In September 1996, EPA and Foote Mineral signed an Administrative Order on Consent pursuant to Sections 104 and 122 of the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended (CERCLA, also known as "Superfund") 42 U.S.C. Sections 9604 and 9622, which required Foote Mineral to conduct a Remedial Investigation and Feasibility Study. A Remedial Investigation (RI) identifies the type and amount of contamination present at the Site and evaluates the risks posed by the Site. The Feasibility Study (FS) uses the information developed in the RI to develop and evaluate possible alternatives to address the contamination and minimize the risks at the Site. Contractors for Foote Mineral began field work for the RI in 1997 and submitted a draft RI Report to EPA in November 1997. After review of that initial document, EPA required significant additional investigation and reporting which, over the next several years, led to additional revised RI and FS reports and one Feasibility Study Amendment (FS Amendment 1). This Record of Decision is based on the information developed throughout these Site investigations and other information gathered or developed for this Site.

In November 2001, as the original investigations were concluding, a previously unsuspected contaminant, bromate, was discovered independently in the public supply well located downgradient, a mile east of the Property. Philadelphia Suburban Water Company (PSW), owner of that well, alerted EPA that bromate was found in the groundwater coming into the well at levels exceeding protective standards and, based on local groundwater flow directions, suggested that the Property was the most likely source of the contaminant. EPA expanded its investigation of the Site to determine the origin of the bromate and evaluate the complications introduced by this chemical.

Bromate is not a common contaminant, and has only recently been regulated in drinking water. The federal Safe Drinking Water Act, 42 U.S.C. §§300f et seq., which specifies acceptable levels

of contaminants in public water supplies by issuing Maximum Contaminant Levels (MCLs), set the MCL for bromate at 10 micrograms of bromate per liter of water, or more commonly, 10 parts per billion (10 ppb). The MCL for bromate became effective in January 2002.

Bromate is an inorganic ion, made up of bromine and oxygen, that is not typically sampled for at Superfund Sites, and it is a chemical that is not detected unless specifically targeted. Bromate was not a product or raw material reported by the Foote Mineral Company, therefore it had never been targeted (and consequently never found) by EPA. Additionally, because of PSW's disinfection processes, the presence of bromate was not anticipated in the PSW well and bromate testing was actually not required for PSW under the new regulation. However, as the effective date for the regulation approached, PSW tested for bromate as an additional safety precaution. Samples indicated that bromate was present in that well at levels that exceeded the MCL, and PSW took the well out of service. Subsequently, several rounds of sampling demonstrated that bromate was also present at high levels in the groundwater beneath the Property and in some nearby home wells. The highest concentrations of bromate were found in a monitoring well in the South Quarry and in a monitoring well immediately downgradient of the South Quarry. Concentrations were found to taper off with distance from the quarry. With the highest concentrations found at the Site and no other apparent sources, bromate was determined to be a Site-related contaminant.

The sampling for bromate exposed a complication in the understanding of the groundwater in the downgradient area. Some wells that had previously not shown evidence of lithium contamination under average weather conditions had become unacceptably contaminated during the winter drought that culminated in Spring 2002. It is believed that under drought conditions groundwater level and flow conditions changed, allowing those wells to draw from contaminated fractures.

In September 2002, as a result of these discoveries, EPA and the current owner of the Property, Frazer Exton Development (FED), signed an Administrative Order on Consent pursuant to Sections 104 and 122 of CERCLA, 42 U.S.C. Sections 9604 and 9622 (Removal Order), which required the immediate supply of bottled water for drinking to residents that were found to have unacceptably contaminated wells, and the design and installation of a waterline extension to connect the impacted residences along Swedesford Road to public water. The Removal Order identified eight residences along Swedesford Road that were impacted or potentially impacted; these were connected to public water. The Removal Order also required the sampling of six additional, further downgradient residential wells and the provision of bottled water to any residence whose well was found to have unacceptable levels of Site-related contaminants. The Removal Order also required the initiation of a long-term residential water monitoring program downgradient of the Site to monitor the safety of the well water of the downgradient residents.

In addition to the eight residences originally designated in the Removal Order, FED has arranged for two additional homes to be connected to public water. These homes were also determined to

have unacceptable concentrations of Site-related contaminants. As of the issuance of this Record of Decision, FED continues to satisfy all of the requirements of that Order.

Because of the discovery of bromate, it became necessary to develop additional Site information and re-evaluate the cleanup alternatives that had been developed for the Site in the FS. Because the various areas of the Site differed in physical characteristics, the Site was split into two Operable Units (OUs) described below.

After bromate was confirmed in the groundwater close to the Site, sampling for bromate was conducted in the surface soils and waste materials on the Property to identify potential bromate sources. A record of the results of this sampling is presented in the 20 September 2002 Feasibility Study Amendment for Operable Unit 1 (FS Amendment 2). Because bromate was not found in any of the soil samples from the Plant Area and North Quarry, these areas were grouped together and designated Operable Unit 1 (OU1) so that these portions of the Site could be advanced toward a remedy. The remainder of the Site, which included the South Quarry and the plume of contaminated groundwater, was separated into Operable Unit 2 (OU2) to undergo further testing to evaluate the extent of bromate contamination and the impact bromate may have on potential cleanup alternatives.

In August 2003, EPA issued a Proposed Remedial Action Plan for this Site. That Plan proposed remedies for both Operable Units: for OU1, excavating and consolidating the contaminated materials from these areas in the North Quarry, then backfilling and capping to the surrounding ground level; and for OU2, backfilling the South Quarry and capping to the level to the surrounding ground level. These actions were expected to eliminate the surface threats and contain the source of groundwater contamination, allowing the plume to dissipate, with the ultimate extent of the plume eventually receding back to the Property line. The remedy for OU2 was only to be implemented after some final studies were completed to show that bromate would be properly addressed by capping.

During the public comment period for that Proposed Remedial Action Plan, an East Whiteland resident informed EPA that the Foote Mineral Superfund Site had also been added to the list of Atomic Weapons Employers (AWE) assembled by the United States' Department of Energy (DOE). Development of the AWE list was required by the Energy Employees Occupational Illness Compensation Program Act of 2000. The internet information supplied by the resident suggested that the Site may have handled the radioactive metals uranium and thorium.

EPA had no company records nor historic information suggesting that the Frazer Facility, which had operated on the Property, had ever handled radioactive materials, and a radiation survey conducted as part of the RI had shown no radiation problem. However, in light of the DOE information, a more sensitive surface radiation survey of the Site was conducted, concurrently with extensive review and evaluation of the records held by EPA and DOE. During the surface survey, six small areas of low level radiation were identified on the Site (Figure 5).

To evaluate the complications brought about by this discovery of radiation, EPA retracted the August 2003 Proposed Plan and required additional investigations.

In March 2004 the current owner of the Property, FED, submitted a Supplemental Radiation Investigation Report to EPA which reported that six, small, well-defined areas on the Property (totaling less than one-third of an acre) displayed radiation levels that exceeded local background radiation levels. Further evaluation of the specific radionuclide concentrations indicated that the radiation was likely the result of residual materials from the ores that were processed at the Site, not the production, storage or handling of atomic weapons or weapons related activities.

In addition to the concern over radiation at the Site, the public raised a concern over the interpretation of groundwater flow at the Site. Therefore, in December 2004, EPA retained the United States Geological Survey (USGS) to perform an independent review of the groundwater modeling and analysis conducted for the Site during the RI/FS. The resulting report (USGS Report) presents an alternate interpretation of groundwater flow and groundwater conditions in and around the South Quarry waste. The conclusions of the USGS Report, presented briefly in the Site Characteristics Section below, indicated that groundwater flows differently than described in the groundwater model used for the Remedial Investigation. Specifically, USGS indicated that the fault zone is not a major driver of the groundwater in the area and that groundwater from beneath the Site flows in a wider, more diffuse path. Also USGS estimated the average level of the surrounding water table to be higher, which indicates that a larger volume of the waste in the South Quarry would be submerged. These conclusions decreased the level of confidence that the capping remedy recommended in EPA's August 2003 Proposed Plan would effectively reduce the contaminants leaching into the groundwater.

In response to concerns about the volume of waste that could remain in contact with groundwater in the South Quarry, FED retained Golder Associates Inc. to evaluate a number of stabilization technologies for potential use on the waste materials in the South Quarry. The initial results of the evaluation were submitted to EPA and are contained in Feasibility Study Amendment No. 3. Based on the information gathered in the Feasibility Study and Amendments, EPA moved forward to recommend the Remedial Alternative that incorporates in-situ soil stabilization presented in the October 2005 Proposed Plan.

III. HIGHLIGHTS OF COMMUNITY PARTICIPATION

On October 12, 2005, pursuant to Section 113(k)(2)(B) of CERCLA, EPA released for public comment the October 2005 Proposed Remedial Action Plan ("Proposed Plan") setting forth EPA's preferred alternative for the Site. The Proposed Plan was based on documents contained in the Administrative Record for the Site. EPA made these documents available to the public in the EPA Administrative Record Room in EPA Region III's Philadelphia office and at the local information repository at the Chester County Library at 400 Exton Square Parkway in Exton. A notice of availability of the Administrative Record was published in the Chester County

Neighbors' Section of the Philadelphia Inquirer, Sunday, October 9, 2005. EPA opened a 30-day public comment period on October 12, 2006, to receive comments on EPA's preferred alternative and the other information presented in the Proposed Plan and Administrative Record. In response to a request for a time extension, the public comment period was extended an additional 30 days to close on December 11, 2005.

A public meeting was held at the East Whiteland Township Building on October 27, 2005. During the meeting EPA staff presented an overview of the events that had occurred at the Site, described how the Superfund cleanup program works, described the remedial alternatives, and explained why EPA recommended the preferred alternative. Following this presentation, EPA answered questions from the citizens regarding the Site and the proposed cleanup.

Questions, comments, and concerns received during the public meeting and throughout the public comment period are categorized and summarized in the Responsiveness Summary attached to this Record of Decision. Each comment is followed by EPA's response.

More detailed documentation on the information contained in this ROD may be found in the Administrative Record for this Site. The Administrative Record include the reports of the Remedial Investigation and Feasibility Study (RI/FS), which are the major studies conducted at Superfund sites to specifically identify the types, quantities, and locations of contaminants, and to develop ways of addressing those contaminants. Also included are the Human Health Risk Assessment (HHRA), the Ecological Risk Assessment Reports and numerous other pertinent documents developed by EPA, the Site Owners, USGS and private citizens. EPA encourages the public to review the Administrative Record in order to gain a more comprehensive understanding of the site and the activities that have been conducted there. The Administrative Record, including hard copies of any oversized images, can also be accessed at the public information repository located at the Chester County Library 400 Exton Square Parkway, Exton, Pennsylvania, Phone: (610) 280-2620. A copy of the Administrative Record, including the oversized images, is also available at EPA Region III Offices located at 1650 Arch Street, Philadelphia, Pennsylvania. For an appointment to review the Record, contact Ms. Anna Butch, Administrative Record Coordinator, at (215) 814-3157. The Administrative Record can also be accessed on the web at www.epa.gov/arweb.

IV. SCOPE AND ROLE OF RESPONSE ACTION

The remedy described in this ROD is intended as a comprehensive and final remedy to address the entire Foote Mineral Co. Superfund Site. The primary objective of the ROD is to reduce or eliminate the potential for continued human and ecological exposure to the waste materials, contaminated soils and contaminated groundwater present at the Site.

The remedy described in this ROD is intended to address the radiation-contaminated soils, and the contaminated soils, process wastes and debris and demolition materials from the Plant Area,

North Quarry and the South Quarry areas. It is expected that the threat of direct exposure from these areas will be virtually eliminated and the release of contaminants from these areas to the groundwater will be minimized, allowing the existing contamination in groundwater to dissipate.

V. SITE CHARACTERISTICS

A. Site Geology and Hydrology

The Site is located in the Chester Valley. Bedrock of the valley floor is made up of largely carbonate limestone and dolomitic rocks. Harder, metamorphic quartzite and schists are found along the valley walls. Chester Valley bedrock is broken by many geologic faults. These faults mostly parallel the east-west axis of the valley. Dolomite of the Ledger formation directly underlies the Property. Directly north of the Property the ground surface is underlain by wedge of Chickies formation quartzite. The boundary between these two rock types is a highly fractured thrust fault zone. This fault zone forms a linear feature that is oriented roughly east-northeast. In the area of the Property the fault almost coincides with the Property's northern boundary.

Groundwater in the Chester Valley flows primarily through the fractures in the bedrock. These fractures may be oriented in many directions so that flow direction in specific locations is variable. The predominant orientation of the fractures is east-northeast, which corresponds to the general orientation of regional groundwater flow.

There have been different interpretations developed for the groundwater flow characteristics in the area of the Site. The two main interpretations used by EPA in the development of this ROD were the interpretation developed by Environmental Resources Management, Inc. (ERM) for the Remedial Investigation, and the interpretation presented by the United States Geological Survey (USGS) in the administrative document entitled Evaluation of Hydrogeology and Ground-water flow and Transport at the Foote Mineral company Superfund Site, East and West Whiteland Townships, Chester County, Pennsylvania. The USGS document was commissioned by EPA in December 2004.

The groundwater conceptual model developed by ERM for the RI envisions the east-northeast trending thrust fault to be highly fractured and acting as a major thoroughfare (or conduit) for the groundwater flow. ERM's conceptual model describes groundwater beneath the Property flowing slowly through the less fractured bedrock to the north and northeast towards the highly fractured east west trending thrust fault. When Site groundwater reaches the thrust fault it turns toward the east-northeast and flows quickly along the fault trace.

Contaminants leaching from sources on the Property enter the groundwater and are carried along the same path. The resulting contaminant plume has been found to be very long and very narrow. The plume has been demonstrated to be more than 9,000 feet and is estimated to extend approximately 10,000 feet east-northeast from the Quarries. The width of the contaminant plume

is narrow as a result of the clean water flowing into the fault zone from both the south and north sides of the valley. This tends to restrict the contaminants to the immediate area of the fault zone. However, wells placed near the fracture zone can pull the contaminated water through connected fractures, enlarging the area of potential impact (indicated as the "Area of Concern" on Figure 3).

The USGS report describes a different groundwater conceptual model. Water table maps referenced in the report do not indicate a groundwater conduit at the fault zone. The USGS conceptual model predicts that the groundwater flow primarily follows a west to east pathway along a wider path through the higher transmissivity Ledger dolomite. The USGS believes the presence of the thrust fault has little impact on the groundwater flow. Therefore, the USGS does not believe the contaminant plume is as narrow as ERM believes. However, the USGS does agree with the length and orientation of the plume described by ERM. EPA has based its selection of remedy on the common elements in both interpretations.

The contaminant plume contains lithium, boron and chromium at levels that decrease with distance from the Property. Lithium, boron and chromium are naturally occurring metals, but are present at higher than natural levels in the contaminant plume. This is due to the high concentration of these materials in the wastes disposed at the Site. The contaminant plume also contains bromate which is a compound of bromine and oxygen. Bromate is not naturally occurring. Bromate levels in the groundwater plume also decrease with distance from the Property.

West Valley Creek flows east to west, and is located near the western border of the Property. West Valley Creek receives surface drainage from the Property. East Valley Creek is located to the north and east of the Property. Some of the groundwater, and contamination, that flows beneath the Property eventually discharges to a section of East Valley Creek near Mill Lane.

The nearest residential properties, as well as some small businesses and office parks, are located on Swedesford and Bacton Hill Roads immediately north and east of the Property. These properties are serviced by a public water system. Further east, but also within the Area of Concern, there are private residential wells and a public water system supply well that had in the past used groundwater as a drinking water supply. The public water supply well was taken out of service immediately after the discovery of bromate. The residential wells in this area are currently being addressed as part of the Removal Order that provides for bottled water and/or a connection to public water. (The Removal Order was discussed further in the Investigations and Regulatory Actions section of this ROD.)

B. Nature and Extent of Contamination

Listed below are the major contaminated areas found at the Site and the nature and extent of the contamination found there. Specific sample results and more extensive information are available in the RI and FS Reports which are contained in the Administrative Record for the Site.

Main Plant Area

The Main Plant Area is the central portion of the Property where facility operations were conducted and there are a number of areas that have been contaminated by those operations.

Soils

The Remedial Investigation identified five areas in the Main Plant Area where the levels of contaminants in the soil result in unacceptable direct contact exposure risks for non-residential uses. When calculating the risk for residential use, additional areas also result in unacceptable levels for direct contact exposure. The risks from these areas are described below in Section VII, Summary of Site Risks. Also identified are numerous areas of soil on the Property that pose a risk of contaminating the underlying groundwater. These areas are indicated in Figure 9.

During the surface radiation survey conducted in 2004, six small discrete areas of soil (totaling less than one-third of an acre) contaminated with radiation were discovered in the Main Plant Area (Figure 5). During direct measurement, those soil areas exhibited 8 to10 times the level of the ambient radiation encountered in the local area. Ambient radiation levels were measured at six nearby non-Site areas and a statistical average ambient radiation level was determined to be 12.2 micro roentgens per hour (μR/hour). This value was derived from the average 9783 counts per minute measurements taken with a Ludlum Model 44-10 gamma scintillator (2 inch by 2 inch sodium iodide crystal). On-Site background locations were also determined with the same instrument and soil samples from these locations were analyzed to determine the background levels of specific radionuclides in the soils. These soil background levels for radionuclides are presented in Table R-1.

At the six areas of above-background radiation, soil cores were extracted to a depth of six feet each. Direct measurement of each core revealed that the highest measurement was always within the top two feet of soil; most within the top foot. Also each core showed background radiation levels at the six foot depth. These measurements indicate that the radiation contamination is restricted to the surface.

The specific radionuclides found in the soils (listed in Table R-1) have been determined to be in ratios similar to those found in nature, indicating that they are likely the residuals of mineral ores processed at the Site, and not the byproducts of enrichment for nuclear processes.

The contaminants of concern identified in water from on-site monitoring wells in the Main Plant Area include the organic chemicals benzene, carbon tetrachloride, trichloroethylene, tetrachloroethylene, ethylbenzene, 1,2-dichloroethane, 1,2-dichloroethene, bromoform and chloroform, as well as the inorganic elements antimony, boron, chromium, lithium, iron, manganese, thallium, arsenic, fluorine and bromate.

During sampling conducted for the Remedial Investigation, a petroleum-like liquid was reported in Monitoring Well 2 in the southern central portion of the Main Plant Area. This material was reported to be floating on top of the water in the well. Liquids that are lighter than water (they float) and form a distinct, separate layer are called LNAPLs, which is short for light non-aqueous phase liquids. LNAPLs are often sources of organic contamination in groundwater. Volatile organic compounds, which may be the residual of petroleum products, were also detected at high levels in the groundwater samples from Monitoring Well 2, but not at the closest downgradient wells. This is an indication that this LNAPL contamination is localized.

Groundwater samples from beneath disposal areas on the Property and from the Quarries were analyzed specifically for radionuclides. No samples exceeded the MCLs for radionuclides in public drinking water. The full results of these analyses are available in the Supplemental Radiation Investigation Report dated 10 March 2004.

North Quarry

The materials disposed in the North Quarry consisted of trash, debris and construction waste, as well as some processed mineral waste. This quarry also received the wash water runoff from a drum cleaning area located on the Site. The waste volume in the North Quarry is estimated to be 43,000 cubic yards. Soil samples have revealed inorganic contamination in locations in the North Quarry - the maximum values for the following inorganics were reported: total chromium at 840 milligrams per kilogram (milligrams per kilogram is a standard reporting level which is abbreviated "mg/kg"), hexavalent chromium at 169 mg/kg, arsenic at179 mg/kg, and lithium at 1,160 mg/kg. Cadmium, silver, boron, selenium and thallium were also detected in some North Quarry samples. Trace amounts of organic compounds were also detected in the samples including the maximum values for 2-hexanone at 24 micrograms per kilogram (micrograms per kilogram is another, much smaller, standard reporting level which is abbreviated "µg/kg"), Toluene at 11 µg/kg, 1,1,1-trichloroethane at 7 µg/kg. Other inorganic and organic contaminants were also detected in the quarry materials. The North Quarry presents an unacceptable risk to individuals, trespassers or workers, who would come into direct contact with the materials contained there. The risks are explained further in Summary of Site Risks, Section VII.

Because it is a large depression, which is only partially filled with waste, the North Quarry functions as a collection basin for stormwater. Stormwater collects in the basin, seeps through the waste, dissolving and picking up contaminants, then enters the groundwater. The average level of the natural water table in the vicinity of the North Quarry has been estimated by ERM to be below the bottom of the quarry. The USGS Report, using a well near the two Quarries and a longer period of analysis, estimated that the natural long-term average water level would be 12.6 feet above the bottom of the quarry. EPA has correlated the USGS data with a well closer to the North Quarry to give an average estimate that would be 6.8 feet above the bottom of the Quarry. However, due to its physical characteristics, the level of the water in the quarry can be significantly higher (this is known as a mounded water table) causing more waste to be saturated, allowing additional contamination to leach into the water.

Comparison of the estimated volumes of groundwater that flows laterally through the waste with the stormwater that collects in the basin and infiltrates through the waste has indicated that over eighty seven percent (87%) of the contamination leaving the quarry is due to the effects of stormwater infiltration.

South Quarry

The volume of waste in the South Quarry has been estimated to be 177,000 cubic yards and is primarily made up of process tailings, which are the wastes left over from extracting lithium from ore. As such, it is the Site's major source of lithium contamination, and provides the major pathway for contamination to enter the groundwater. Wells in and immediately downgradient of the South Quarry have displayed the highest concentrations of lithium, boron, chromium and bromate. The risks are explained further in Summary of Site Risks, Section VII.

The process tailings waste was originally pumped into the South Quarry as a slurry (very fine waste particles in a water suspension) and allowed to settle. Presently, the waste is about 60 feet thick, from the bottom of the South Quarry to the surface of the waste. Under natural conditions the water table is typically above the bottom of the quarry and in the waste. Therefore, the bottom portion of the waste is usually saturated and subject to groundwater washing through it from side to side, picking up contamination, as it flows in its natural path.

Similar to the North Quarry, the South Quarry is a large open surface depression which functions as a stormwater collection basin, allowing collected stormwater to seep through the waste into the groundwater. Subsequently, the water table in the South Quarry is also mounded, and to a greater extent than evidenced in the North Quarry. Also similar to the North Quarry, it is estimated that over eighty seven percent (87%) of the contamination leaving the quarry is due to the effects of stormwater infiltration.

Downgradient Contaminant Plume

During the RI/FS, information was gathered and analyzed to determine the behavior of the groundwater and contaminants around the Site. It is necessary to understand local groundwater flow in order to understand and predict how contaminants present in the groundwater will migrate. This information was developed using monitoring wells installed on the Property, and residential and public water supply wells in the areas surrounding the Property, especially the downgradient area which lies to the east.

In the groundwater conceptual model developed by ERM for the RI/FS, contaminants contained in the wastes from the Quarries and in some of the facility soils dissolve in rainwater and other precipitation that soaks through the ground, moving downward into the underlying groundwater. These contaminants are then carried with the groundwater as it flows, relatively slowly, north and northeast from immediately beneath the Property to the contact fault zone which is located very close to the northern border of the Property (see Figure 7.) At the fault zone, the contaminated

groundwater changes direction and flows east-northeast at a much faster rate. This change in direction and speed is caused by the presence of the fault zone and the other hydrologic influences that form a groundwater trough funneling the water in a generally east-northeast direction. From the north border of the Property the contaminated water flows in the direction of the groundwater trough, becoming more dilute as it mixes with other waters flowing into the trough. Some of the contaminated water flowing in the trough discharges into East Valley Creek about 8000 feet east of the Quarries, near the intersection of Route 401 and Mill Lane. Low levels of Site related contamination have been detected beyond East Valley Creek indicating that some of the contaminated groundwater flows under the creek and continues flowing in the direction of the fault zone. The groundwater that contains Site-related contamination, stretching from the source areas to the furthest detections of contamination in the groundwater is called the "Downgradient Contaminant Plume".

In ERM's groundwater model, the extent of the Downgradient Contaminant Plume is depicted conceptually as the three areas in Figure 3. Area A represents the entire Property (including the clean, western portion and the contaminated source areas in the Main Plant Area and Quarries). As discussed in the Sections V and VII, on some parts of the Property, contaminants in the soils can migrate downward and enter the groundwater directly underneath. Area B is that area immediately east of the Property where groundwater coming from beneath the Property flows slowly through fractures in the bedrock to the north and northeast, carrying high concentrations of Site contaminants before entering the groundwater trough. And the long and very narrow Area C (approximated on Figure 3 as the narrow, almost straight, dashed line) is the area that includes the contact fault zone heading east-northeast and the groundwater trough that coincides with it.

If the groundwater in this area were not influenced by actively pumping groundwater wells, ERM's groundwater conceptual model predicts that the contamination would stay within the areas described above. However, because of interconnected fractures in the bedrock, groundwater wells located near the contaminant plume in Areas B and C could draw contaminated water away from the depicted areas, expanding the area where wells could be contaminated. To account for this potential impact of contamination, an Area of Concern surrounding the fault zone and the predicted groundwater trough has been approximated and is depicted on Figure 3. The Area of Concern is immediately adjacent to the fault line, including all the areas from the Main Plant Area and the Quarries on the Property, through Area B and Area C past the discharge at East Valley Creek to an estimated distance of approximately 10,000 feet from the Property. The Area of Concern represents the area where new wells could be contaminated with Site-related contaminants. The contaminants of concern in the contaminant plume are lithium, boron, chromium and bromate Some of the known contaminated wells in the area of concern were sampled in January 2003. The results of that sampling event are shown in Figure 4. Several residential wells located to the north or south of the contact fault zone display levels of lithium and bromate. It should be noted that some residential wells that are clearly within the Area of Concern have never shown contamination; those wells, simply by chance, were installed in and draw water from uncontaminated fractures.

As discussed above, the groundwater conceptual model represented in the USGS Report portrays groundwater and contaminant flow in the downgradient area without the well-defined groundwater trough or differentiated flow areas. Instead, the flow is expected to be more evenly distributed and slower moving as it flows in a wider path from beneath the source areas on the Property in an east-northeast direction. However, the Area of Concern derived from general hydrogeologic principles can be estimated to be an area relatively the same as that depicted in Figure 3, because the contaminated groundwater would generally follow the axis of Chester Valley, parallel to the fault zone, constrained by the inward flow of water from the surrounding area (Figure 8).

For the purposes of remedy selection, EPA has based its decision on the conclusions that can be drawn from both the ERM and USGS interpretations, specifically the length and orientation of the Area of Concern and the relatively narrow aspect of the downgradient contaminant plume. However, the two groundwater interpretations clearly do not agree on predicted cleanup times. During the remedy selection process, EPA has also considered this disagreement and the subsequent uncertainty in the prediction of cleanup times. Therefore ERM's predicted cleanup times, discussed in the comparative analysis of Section X below, are presented for comparison purposes only, with the caveat that actual times may be significantly different than predicted.

The Area of Concern associated with the Foote Mineral Superfund Site has been estimated to extend approximately 10,000 feet away from the Property, based on concentrations found in residential well samples. Lithium above the Preliminary Remediation Goal of 260 ppb (the basis for this number is explained in the Human Health Risk Assessment section of this ROD) has been detected in a residential well as far as 7300 feet away, while bromate above its Maximum Contaminant Level of 10 ppb has been detected in a residential well at a distance of 9200 feet from the Property. Although boron and chromium are also associated with the Site, they reach acceptable levels in groundwater closer to the Property; therefore, remedies that address the more extensive lithium and bromate will also address boron and chromium. As noted above, the contaminants traveling in groundwater appear to reach different distances away from the Property. This is due to the different starting concentrations from the source areas, as well as the different tendencies of each contaminant to adhere to, or interact with, the rock and soil materials the groundwater flows through. The most significant example of this is the difference between lithium, which starts at the highest concentration levels near the Property (in the hundreds of thousands of ppb), and bromate which, although it starts at a significantly lower concentration near the Property (around one thousand ppb), persists in the groundwater and travels even further from the Property.

Groundwater movement at the Site is controlled by fractures in the carbonate bedrock aquifer. Bedrock fractures become enlarged by dissolution of the carbonate rock which, in the extreme, can lead to the karst conditions that have been identified in other nearby parts of Chester County. The dissolution of the carbonate material leaves a residual of clay material in the solution channels. It is believed that the presence of clay within the solutions channels is retarding the migration of lithium within the contaminant plume.

Because lithium ions are positively charged, they are attracted to, and can become bound to, the clays in the subsurface which normally exhibit a negative surface charge. This bonding effect can reduce the levels of lithium in the water as it flows away from the source. Bromate ions, however, are negatively charged and would be repelled by the negatively charged clay surfaces allowing them to stay in the water and travel farther.

Wells in the Area of Concern that have been found to be contaminated are no longer used for drinking water, are treated prior to use, or have been taken out of service. However, if new wells were to be installed in the Area of Concern near the fault zone to the east of the Property, those wells could draw water from fractures having unacceptable levels of contamination.

VI. CURRENT AND POTENTIAL FUTURE LAND AND RESOURCE USES

The Property, the source of contamination for this Site, is the currently unused location of a former mineral and chemical processing facility including the two Quarries and the Main Plant Area. In the late 1990's, the buildings were demolished to the foundations in order to minimize the danger from the deteriorating structures. The field in the western portion of the Property was used for raising crops in the past but currently lies fallow. Historically the area surrounding the Property was mixed commercial/residential /agricultural.

The Property is bordered on the north by Swedesford Road and a former Conrail railroad right of way. Recent residential developments have been constructed on the north side of Swedesford Road and the former railroad right of way has been converted to a recreational trail. Immediately to the south is PECO Energy's Planebrook station 202. West of the Property, past the former corn field and West Valley Creek, is Property formerly owned by the Church Farm School, including the new commercial development at Valley Creek Boulevard. Immediately east of the Site are the businesses and residences located on South Bacton Hill Road. The area further to the east, in the area of the Downgradient Contaminant Plume, is primarily residential, with single family dwellings, and a golf course. Residential water supply wells in the Downgradient Contaminant Plume Area have been included in a groundwater monitoring program, with several wells taken out of service and replaced with public water connections. Although the natural flow of groundwater in the area tends to direct the contaminants into the narrow zone adjacent to the fault (depicted as the Area of Concern in Figure 3), and the currently identified residents in that area no longer use their wells for drinking water, any new wells placed in or very near the fault could draw contaminated water. Therefore, the remedy described in this ROD calls for groundwater use restrictions described in Section XII below.

The Property is currently owned by Frazer Exton Development, a partnership that has announced their intent to redevelop the Property as part of an age-restricted residential community. Current plans describe a phased approach, with the development of 800 residential units primarily on the Western (clean) portion of the Property as the first phase. With almost two hundred units already reserved, the owner hopes to start construction activities concurrent with the cleanup activities for the eastern portion. The long-term plan for the development includes the potential for

additional phases expanding the residential community to the Main Plant Area following cleanup of that area.

VII. SUMMARY OF SITE RISKS

A. Human Health Risk Assessment Summary

The purpose of the Human Health Risk Assessment (HHRA) is to establish the degree of risk or hazard posed by contaminants at a Site, and to describe the routes by which humans could come into contact with these contaminants. A separate analysis is conducted for those substances that can cause cancer (carcinogenic) and for those that do not cause cancer (non-carcinogenic), but still may cause adverse health effects.

Under the National Oil and Hazardous Substances Pollution Contingency Plan, 40 CFR Part 300 (NCP), EPA has established acceptable levels of carcinogenic risk for Superfund sites ranging from one excess cancer case per ten thousand, to one excess cancer case per one million people exposed to site-related contaminants. This risk range, expressed in standard scientific notation, is between 1E-04 (one in ten thousand) and 1E-06 (one in one million). Remedial action is generally warranted at a site when the calculated cancer risk level is greater than 1E-04. However, since EPA's cleanup goal is generally to reduce the risk to 1E-06 or less, EPA also may take action where the risk is within the range between 1E-04 and 1E-06.

The NCP also states that sites should not pose a health threat due to a non-carcinogenic, but otherwise hazardous condition. EPA defines a non-carcinogenic threat by the ratio of the contaminant concentration at a site that a person may encounter to the established safe concentration. If the ratio, called the Hazard Index (HI), exceeds one (1), there may be concern for potential non-carcinogenic health effects associated with exposure to the contaminants at a site. The HI identifies the potential for the most sensitive individuals to be adversely affected by the non-carcinogenic effects of chemicals. Above a Hazard Index value of 1, adverse effects do not necessarily occur, but can no longer be ruled out. As a rule, the greater the value of the HI above 1, the greater the level of concern.

The media of concern evaluated in the HHRA were soil, surface water, groundwater, and sediments. The risks, summarized below, were estimated based on hypothetical groups, including future onsite workers, future onsite child residents, future onsite adult residents and occasional trespassers, that could be exposed to the contaminants from the Site. It should be noted that these risks refer to conservative toxicity values and long-term exposure times, and do not represent risks from a one-time encounter with contaminants at the Site. Detailed descriptions of the risk factors and risk scenarios are included in the HHRA in the Remedial Investigation Report, which is in the Administrative Record.

Soils

The following areas of the Site have been found to present an unacceptable human health risk to a hypothetical future resident due to direct contact with soils and waste materials. It is important to note that some of the risks may be due to naturally occurring metals and during the design of a remedy, further investigation will determine whether the levels are actually background conditions. Since many metals are a natural part of soil, the final HHRA does not include those substances already attributed to background conditions. The following areas demonstrated an unacceptable health risk to potential future adult and child residents. The cancer risks listed are the total for the child and adult; the Hazard Indices (HIs) listed are developed for a child resident. Currently, the most likely future use of the Site is for an age-restricted residential development which would prohibit children under the age of 18 living at the development. However using child risk is considered a reasonable precaution as future use of the Property could change.

North Quarry - HI = 50, largely due to manganese, antimony, vanadium, thallium, arsenic and iron.

The Former Wash Pond Area - HI = 34 and excess cancer risk = 6E-4, largely due to vanadium, arsenic, thallium, hafnium, iron and mercury.

Building 20 Transformer Area - excess cancer risk = 7E-4, largely due Aroclor 1260, which is a polychlorinated biphenyl (PCB)

Operational Area Sediments - HI = 42, largely due to vanadium, thallium, antimony, iron, arsenic, copper and lithium.

Building 45 Pile - HI =9, largely due to iron, vanadium, antimony, iron and arsenic.

Building 18/19/19A Tanks and Tank Cradle Area - HI = 18, largely due to iron, vanadium, antimony, iron and arsenic.

An addendum to the HHRA, the 26 April 2004 Supplemental Human Health Risk Assessment, also identified the Chromite Ore Storage Area, Building 16, Building 16A Discharge Area and the Tanks adjacent to Building 23 as soil areas with unacceptable direct contact risks to potential future adult and child residents. Five additional areas on the Property (South Quarry, Solvent Burn Area, Building 30, Building 40, and Building 17) present unacceptable direct contact risks only to child residents.

Soils in certain areas of the site have also been identified as a risk for groundwater contamination. If these soils are left in place, uncovered, the contamination in the soils could continue to impact groundwater above drinking water standards. Soil screening levels (SSLs) were calculated in the Feasibility Study according to EPA's Soil Screening Guidance (May 1996) to identify the soil contaminant concentrations which may lead to unacceptable risks in

groundwater as a result of soil-to-groundwater migration of contaminants. Soil areas with levels that exceeded the SSLs were identified as "groundwater risk soils." As reported in the June 2001 Feasibility Study Report these groundwater risk soil areas include all of the direct contact risk areas listed above and the Sump Area Sediments, Equalization Basin Sediments, Former Settling Ponds Sediments, South Quarry, Building 16, Building 16A Discharge Area, Building 17 Storage Pads, Building 30 Storage Area, Building 40 Pile, Colemanite Ore Storage Area, Chromite Ore Storage Areas, Piles Near Equalization Basin, Former Settling Ponds Area, Former Solvent Burn Area, Former Septic System Area, Farm Field Area (this is a small area at the western edge of the Main Plant Area, not the undeveloped western portion of the Property which is not considered part of the Site), Arsenite Disposal Area and the Wastewater Equalization Basin. The groundwater risk soil areas and the direct contact risk areas are depicted in Figure 9. Revised Soil Screening Levels for the contaminants of concern at this Site are presented in Table I. These revised SSLs are based on the drinking water MCLs and risk-based standards presented in Table III. The groundwater risk soil areas are also listed in Table II with their estimated surface areas and depths.

TABLE I
SITE SPECIFIC SOIL SCREENING LEVELS (SSLs)

Chemical	SSL (mg/kg)
Benzene	0.021
Bromoform	0.748
Carbon tetrachloride	0.0469
Chloroform	0.417
Ethylbenzene	9.47
Tetrachloroethene (PCE)	0.278
Trichloroethene (TCE)	0.0387
1,2-Dichloroethane	0.045
1,2-Dichloroethene	0.326
Antimony	2.25
Arsenic	3.14
Chromium	20.5
Fluoride	6,424
Iron	881
Manganese	39
Thallium	0.380
Boron	150
Lithium	17.3

mg/kg - milligrams of contaminant per kilogram of soil

TABLE II
GROUNDWATER RISK SOIL AREAS AND DIRECT CONTACT RISK SOIL AREAS

Site Area	Risk		Area (ft^2)	Estimated Depth (ft)
	Direct Contact	Groundwater		
North Quarry	Yes	Yes	76,000	15
Former Wash Pond Area	Yes	Yes	5,000	22
Building 20 Transformer Area	Yes	Yes	1,100	0.5
Operational Sediments	Yes	Yes	18,100	0.5
Building 18/19/19A Tanks and Tank Cradles Area	Yes	Yes	3,500	0.5
Building 45 Pile	Yes	Yes	2,600	0.5
Sump Area Sediments	No	Yes	1,000	0.5
Equalization Basin Sediments	No	Yes	700	0.5
Former Settling Pond Sediments	No	Yes	9,000	0.5
South Quarry	Yes	Yes	130,000	37
Building 16	Yes	Yes	700	0.5
Building 16A Discharge Area	No	Yes	1,600	0.5
Building 17 Storage Pads	Yes	Yes	6,800	10
Building 30 Storage Area	Yes	Yes	700	0.5
Building 40 Pile	Yes	Yes	2,200	0.5
Colemanite Ore Storage Area	No	Yes	4,700	10
Chromite Ore Storage Area	Yes	Yes	7,000	14
Piles near Equalization Basin	No	Yes	3,300	0.5
Former Settling Ponds	No	Yes	30,000	22
Former Solvent Burn Area	Yes	Yes	31,200	45
Former Septic System Area	No	Yes	5,300	27
Farm Field Area	No	Yes	3,400	0.5
Arsenite Disposal Area	No	Yes	1,500	0.5
Wastewater Equalization Basin	No	Yes	13,000	3

The discovery of six soil areas with low levels of radiation was made after the HHRA was completed. As such the HHRA does not contain an evaluation of the risks from radiation found at the Site. However, the Supplemental Radiation Investigation Report dated 10 March 2004 characterizes these risks, and they are summarized below under Radiation.

Groundwater

Contamination from the Site has been found to present an unacceptable risk to current users of the groundwater. Analysis of samples taken from residential wells downgradient of the Property have shown that contamination has migrated away from the Property, and has impacted downgradient residential wells. Risk assessments were conducted using data from these wells and documented in three EPA memoranda dated 8/8/02, 10/31/02 and 11/13/02. The risk assessments concluded that there were unacceptable health risks at the evaluated residences from lithium and bromate. These residences have been supplied with bottled water for drinking purposes or a permanent connection to public water has been provided pursuant to the Removal Order.

Evaluation of potential future exposure to groundwater was conducted in the HHRA. Although the HHRA was compiled prior to the discovery of bromate, and therefore does not describe the risks derived from the presence of bromate in the groundwater, the HHRA had already determined an unacceptable risk to groundwater users from the presence of lithium, boron and chromium. Volatile organic compounds have been found in groundwater in the monitoring wells located on the Property near the Solvent Burn Pit and Monitoring Well 2 where the LNAPL was discovered during the RI. The presence of these contaminants would cause an unacceptable cancer risk for a hypothetical future resident using that water. Currently, however, no one uses the water from beneath the Property.

For these reasons, EPA has determined that hazardous substances from ths Site, if not addressed by a remedial action, present a current and potential future threat to public health, welfare, or the environment. Therefore, Preliminary Remediation Goals (PRGs) have been developed for the Site. PRGs are target cleanup levels that EPA considers safe for drinking. The PRGs identified for this Site so far are listed in Table III.

TABLE III
PRELIMINARY REMEDIATION GOALS FOR GROUNDWATER

Chemical	Not-to-Exceed Concentration (ug/L)
Benzene	5 (MCL)
Carbon tetrachloride	5 (MCL)
Chloroform + bromoform (Together as Total Trihalomethanes)	80 (MCL)
Chloroform	70 (MCLG)
Tetrachloroethene	5 (MCL)
Trichloroethene	5 (MCL)
Ethylbenzene	700 (MCL)
1,2-Dichloroethane	5 (MCL)
1,2-Dichloroethene	70 (cis); 100 (trans) (MCL)
Antimony	6 (MCL)
Arsenic	10 (MCL)
Chromium	100 (MCL)
Fluoride	4000 (MCL)
Thallium	0.5 (MCLG)
Boron	1340 (RBR)
Lithium	260 (RBR)
Bromate	10 (MCL)

For groundwater to be considered safe for drinking, the concentrations of contaminants may not exceed the levels listed in this table (except where background concentrations are higher, as described below). Additionally, the total cancer risk for Site-related contaminants in groundwater shall not exceed EPA's acceptable cancer risk range (1E-4 to 1E-6), and the target organ Hazard Indexes for Site-related groundwater chemicals shall not exceed 1. These risks shall be determined by the performance of a confirmatory risk assessment when it is believed that groundwater cleanup has been achieved.

For the most part, these not-to-exceed concentrations were based on Maximum Contaminant Levels (MCLs) and non-zero Maximum Contaminant Level Goals (MCLGs) pursuant to the federal Safe Drinking Water Act; chemicals without MCLs or MCLGs used risk-based standards (RBR) developed during the RI/FS process.

Furthermore, the above-cited not-to-exceed and risk-based standards may be superseded by local background concentrations for inorganic compounds other than lithium (i.e., cleanup will not be required below background levels for these inorganics).

Surface Water and Sediments

During the Remedial Investigation, surface water samples from East Valley Creek and the equalization basin on the Property were collected and analyzed for contamination. Potential exposures to those surface water samples were assessed under the assumptions of hypothetical future on-site residents. There were no unacceptable carcinogenic or noncarcinogenic risks demonstrated for the residential populations. Because the residential assumptions are the most conservative estimation of potential risk, other potentially exposed populations (e.g., on-site worker, trespasser) would have even lower potential risks. Potential exposures to sediments in the Pond, East Valley Creek and West Valley Creek, and the drainage ditch flowing to the Creek were also assessed for hypothetical future on-site residents. Consistent with the surface water results, there were no unacceptable carcinogenic or noncarcinogenic risks.

Radiation

The Supplemental Radiation Investigation was conducted to identify areas of radiological concern and evaluate risks from those areas. The investigation determined that no elevated radiation exposure levels were found at or near the Property boundaries. Therefore there are no current Site-related radiation exposure risks to the general public. Even the potential exposure to an occasional trespasser would be negligible. An occasional trespasser spending one hour directly above the highest detected radiation level would experience an additional cancer risk of 1.35E-8 (1-1/3 additional chances of cancer in 100 million, or 1-1/3 in 100,000,000) However, if left in place, redevelopment of the Property could result in increased future risk levels due to increased exposure times associated with commercial or residential usage.

B. Summary of Ecological Risk Assessment

When the original draft of the RI Report was reviewed, EPA determined that additional information was necessary to fully evaluate any impacts to ecological receptors, specifically in East and West Valley Creeks where groundwater discharge and surface water runoff were entering the streams. As a continuing part of the RI, a plan for a Phase II Ecological Risk Assessment was developed to further identify and characterize any impacts to the environment and ecological receptors potentially impacted by the Site.

Additional water and sediment sampling, and subsequent analysis for lithium and boron, were conducted in both East and West Valley Creeks. Because there is little information available on the effects of lithium exposure on water-dwelling organisms, water and sediment from the streams were collected for toxicity testing on some representative organisms. In addition to the toxicity tests, fish tissue analysis was conducted on some of the indigenous fish community in East Valley Creek.

Results of the investigation were presented in the Phase II Ecological Risk Assessment Report which was submitted to EPA on June 8, 2001 for review and was subsequently approved.

Results from West Valley Creek showed no evidence of Site-related impact on water or sediment. However, results from East Valley Creek indicate that there are elevated levels of lithium and boron in the stream. Differences in the invertebrate and fish communities in East Valley Creek are correlated with degree of contamination. The incidence of the alterations in fish tissue is also correlated with the contamination of surface water in the creek, but the implication for fish populations is unknown due to the nature of the alterations. The observed differences in the aquatic community support the elimination of contaminant migration with the ultimate objective of achieving background surface water concentrations of Site-related contaminants.

The Ecological Risk Assessment was developed prior to the discovery of bromate. However, because the assessment evaluated the overall toxicity of the water and sediment, which would indicate the impacts of all contaminants present, the conclusions of the assessment remain unchanged.

VIII. REMEDIAL ACTION OBJECTIVES

The HHRA identifies the areas of the Foote Site that present unacceptable health risks due to the contamination contained in those areas and the current or potential exposure pathways. The groundwater moving away from the Property contains site-related contaminants that present a potential unacceptable risk to nearby downgradient residents that would use the impacted water as a drinking supply; however, the level of potential risk declines with distance from the Property as the contaminants are diluted, impeded or otherwise reduced in the groundwater until they reach safe levels. As outlined in the NCP, EPA expects to return ground water to beneficial use wherever practicable within a timeframe that is reasonable given the particular circumstances of a site. When restoration of ground water to beneficial use is not practicable, EPA expects to prevent further migration of the plume, prevent exposure to the contaminated ground water, and evaluate further risk reduction. Returning the ground water to its beneficial use is addressed by reducing the concentration of contaminants in ground water and eliminating, stabilizing, or minimizing the further migration of contaminated ground water.

Remedial action objectives are intended to be specific to the affected media, but sufficiently broad so as to not restrict the potential remedial technologies available. The remedial action objectives for this Site are as follows:

- reduce or eliminate risk posed by direct human contact with the waste materials in the Quarries and contaminated soils present at the Site;
- reduce or eliminate the potential for direct human or ecological exposure to radiologically contaminated soils;
- minimize the potential human and ecological exposure to unacceptably contaminated groundwater;

- reduce the contamination leaching into the groundwater to allow the groundwater in the Downgradient Contaminant Plume to be returned to beneficial use; and
- comply with applicable or relevant and appropriate regulations.

IX. SUMMARY OF REMEDIAL ACTION ALTERNATIVES

CERCLA (the law commonly referred to as Superfund) requires that any remedy selected to address contamination at a hazardous waste site must be protective of public health, welfare, and the environment; cost-effective; in compliance with regulatory and statutory provisions that are applicable or relevant and appropriate requirements (ARARs); and consistent with the NCP to the extent practicable. CERCLA also expresses a preference for permanent solutions, for treating hazardous substances onsite, and for applying alternative or innovative technologies.

The Feasibility Study Report, taken together with the 20 September 2002 Feasibility Study Amendment for Operable Unit OU-1, the 3 June 2004 Second Feasibility Study Amendment, and the 31 March 2005 Feasibility Study Amendment No. 3, discusses a full range of alternatives and alternative amendments evaluated for the Site and provides the supporting information for the alternatives and amendments presented in this Record of Decision. A No Action Alternative, as required by the NCP at 40 CFR §300.430 (e)(6), is presented with other alternatives that have been determined by EPA to be protective of human health and the environment, achieve state and federal regulatory requirements, and achieve the cleanup goals for the Site.

The alternatives summarized in Table IV, and described in more detail below, are those which were developed specifically to the characteristics of this Site, retained through screening for suitability, and finally carried through a detailed analysis and evaluation against the nine criteria in the NCP. These alternatives were developed in the original RI/FS documents, in FS Amendment 1 and in preparation for the August 2003 Proposed Plan. These alternatives were developed in accordance with EPA's Guidance for Conducting Remedial Investigations/Feasibility Studies under CERCLA, OSWER Directive No. 9355.3-01, October 1988, and are explained in more detail in the Feasibility Study Report and amendments.

The alternative amendments summarized in Table V were developed separately in response to the bromate and radiation contamination discovered after the initial Feasibility Study was completed and the August 2003 Proposed Plan was released to the public. The alternative amendments were developed as components to be added to and considered as part of the original alternatives. As such they are not compared with the original alternatives, rather they are evaluated independently by the additional benefits they would provide if implemented with the original alternatives.

TABLE IV
SUMMARY OF MAJOR COMPONENTS OF REMEDIAL ACTION ALTERNATIVES

	ALTERNATIVE	KEY COMPONENTS OF ALTERNATIVE
1	**No Action**	• Other than Annual Monitoring and Five-year Reviews, No Specific Actions Would Be Taken to Address Site Contamination or Risks
2	**Containment by Capping of the Contaminated Soil Areas and Quarries (at existing depth)**	• Site Preparation, Removal of Foundation Slabs and Equalization Basin for Consolidation into the Quarries, and Regrading for Proper Site Drainage • Removing LNAPL from MW-2 • Capping All Contaminated Soil Areas with Asphalt or Engineered Geosynthetic Caps • Capping Quarries at Current Elevation with Engineered Geosynthetic Caps Installed in Depressions • Pumping Accumulated Rainwater from Quarry Areas with Discharge to Stream • Water Use Restrictions on the Property, Groundwater and Surface Water Monitoring and Implementation of a Groundwater Management Zone in Plume Area • Five-year Reviews
2a 2b	**Containment by Consolidation and Capping of the Quarries at Surrounding Elevations**	**(This Alternative is a component of the Preferred Remedy proposed in the October 2005 Proposed Plan and selected in this ROD)** • Site Preparation, Removal of Foundation Slabs and Equalization Basin for Consolidation into the Quarries, and Regrading for Proper Site Drainage • Removing LNAPL from MW-2 • All Contaminated Soil Areas Excavated and Consolidated into the Quarries • Quarries Filled and Capped at the Surrounding Elevations. 2a differs from 2b only in the capping Materials for the Quarries. - **2a** calls for Asphalt Caps. - **2b** calls for Engineered Geosynthetic Caps. • Water Use Restrictions on the Property, Groundwater and Surface Water Monitoring and Implementation of a Groundwater Management Zone in Plume Area • Five-year Reviews

3	**Containment by Capping and Subsurface barrier Wall**	• Site Preparation, Removal of Foundation Slabs and Equalization Basin, and Regrading for Proper Site Drainage • Removing LNAPL from MW-2 • Capping the Groundwater Risk Soils with Asphalt, Excavating the Direct Contact Risk Soils and the North Quarry Materials and Consolidating them into the South Quarry • Filling the South Quarry to the Surrounding Elevation and Capping with Engineered Geosynthetic Cap • Installation of a Subsurface Barrier around the South Quarry to Inhibit Groundwater Flow Through the Materials • Water Use Restrictions on the Property, Groundwater and Surface Water Monitoring and Implementation of a Groundwater Management Zone in Plume Area • Five-year Reviews
4	**Containment by Capping, Groundwater Recovery and Treatment**	This Alternative Is Identical to Alternative 2 with the Addition of a Treatment Plant and Three Groundwater Extraction Wells on the Property to Extract Contaminated Groundwater, Treat It and Discharge the Treated Water to Surface Water. Extraction and Treatment of the Groundwater Would Help Minimize the Amount of Contamination leaving the Property.
5	**Containment by Capping with Groundwater Diversion**	This Alternative Is Identical to Alternative 2 with the Addition of an Extraction Well to Recover Uncontaminated Water from the Western End of the Property for Reinjection Beyond the Eastern Property Boundary. Reinjection Would Act to Further Contain the Contaminated Groundwater and Redirect its Flow
6	**Excavation and Off-Site Disposal**	• Excavation and Off-Site Disposal of all Quarry Materials and Contaminated Soils • Regrading for Proper Site Drainage • Removal of LNAPL from MW-2 • Water Use Restrictions on the Property, Groundwater and Surface Water Monitoring and Implementation of a Groundwater Management Zone in Plume Area • Five-year Reviews
7	**Containment by Consolidation and Capping of the Quarries at Surrounding Elevations** **<u>Phased Approach</u>: OU1 implemented immediately, OU2 implemented following confirmation study.**	**This Alternative was proposed as EPA's Preferred Alternative in the August 2003 Proposed Plan, which was subsequently retracted.** As presented in the August 2003 Proposed Plan, this Alternative has the same components in Alternative 2a/2b, but conducted in a phased approach. The components for OU1 would be implemented immediately as a final remedy. The components for OU2 would be implemented following additional studies to confirm that capping is appropriate for addressing the bromate contamination. Because the additional studies have been completed a phased approach is no longer appropriate, making this alternative identical to Alternative 2a/2b.

Common Elements in the Evaluated Alternatives

Because of the benefits recognized during screening of some of the elements of the remedial alternatives, they are included in most or all of the alternatives and are described below.

All of the alternatives include Five-year Reviews. Where a remedy allows waste to remain on-Site, such that the Site does not allow unrestricted use and unlimited access, reviews of the implemented remedy are to be conducted at least every five years pursuant to Section 121(c) of CERCLA, 42 U.S.C. 9621(c), to ensure that the remedy remains protective. If it is determined from the results of the Long-term Monitoring or Five-year Reviews that the remedy is no longer protective, additional response actions may be taken. The costs associated with Long-term Monitoring and Five-year Reviews are included in each alternative's O&M cost estimate.

All of the alternatives also include long-term Monitoring of representative monitoring wells on the Property, downgradient residential wells that are impacted or potentially impacted, and surface water locations on East Valley Creek. The specific wells and sampling locations, as well as the frequency of sampling will be decided during the Remedial Design phase. To ensure that information developed by the monitoring program will be representative of the changing groundwater conditions, the available downgradient wells will be evaluated and the construction of additional monitoring wells may be required. The selected wells will be analyzed for representative contaminants starting with the chemicals listed in Table III above, however the list of chemicals may be revised during the development and implementation of the monitoring plan to represent groundwater quality and cleanup goals at this Site. For the purpose of generating a comparative cost estimate, the FS contemplated eight residential wells to be sampled annually for lithium, boron and chromium, and nine facility wells to be sampled annually for lithium, boron and chromium as well as a number of other representative contaminants. Initially, however, sampling will be more frequent (semi-annually or quarterly) to establish a baseline. Additionally, it is anticipated that at least two surface water samples would be analyzed annually for lithium, boron, and chromium. In Alternatives 2 through 7 the downgradient sampling will be reduced or discontinued as the levels of contaminants diminish over time. Alternative 1 would likely result in unacceptable downgradient contaminant levels for hundreds of years. The long-term monitoring program will continue until the wells being sampled indicate that groundwater contaminants have been reduced to, and are expected to remain at, acceptable levels.

All of the alternatives, except No Action, also include the removal of LNAPL in MW-2. The free-product LNAPL observed in MW-2 during the RI will be removed with a passive recovery device or oil-absorbent boom placed within the well. The recovered material will be analyzed and disposed of properly in accordance with the regulations determined to be appropriate to the results of the analysis. When recovery becomes impractical (i.e., low recovery efficiency), an oxygen release compound would be utilized to enhance biodegradation of any residual petroleum contamination in this area.

All of the alternatives, except No Action, include institutional controls to prevent residential land use of the contaminated portions of the Property and to preserve the selected remedy.

Institutional controls (access requirements and use restrictions through measures such as easements and covenants, title notices and orders or agreements with EPA, PADEP or Chester County) will be implemented in order to protect the implementation, integrity and protectiveness of the remedial action. In particular, such institutional controls include, but are not limited to, prohibiting disturbance of the constructed caps and contained waste, preventing the use of the capped areas for residential purposes and notifying current and future owners of the Property of the affected groundwater, soil contamination and Quarry fill left at the conclusions of the remedial actions. In the alternatives where consolidation of contaminated materials is employed, the institutional controls would apply to the areas where the materials are consolidated and capped. Additionally, institutional controls will be pursued for the parts of the Property that are within the Area of Concern described in Section V, Site Characteristics, to prevent the installation and use of untreated groundwater wells for drinking water purposes.

All of the alternatives, except No Action, include institutional controls, in the form of a groundwater management zone for the Area of Concern described under Nature and Extent of Contamination in Section V. Institutional controls (access requirements and use restrictions through measures such as easements and covenants, title notices and orders or agreements with EPA, PADEP or Chester County) will be implemented in order to protect the implementation, integrity and protectiveness of the remedial action. This groundwater management zone will be developed by EPA in consultation with Pennsylvania Department of Environmental Resources, Chester County Health Department's well permitting program and East Whiteland Township's land development process to minimize the potential for exposure to contaminated groundwater. This groundwater management zone may entail restrictions on installation of new wells in areas directly adjacent to the geologic contact fault, mandatory sampling for Site-related contaminants on new wells and other methods of identifying or limiting exposure. The extent and requirements for this zone are expected to be revised with time as contaminants are depleted and the extent of the plume shrinks.

Because the Feasibility Study was finalized in 2001, all of the alternatives provide cost estimates developed in 2001 dollars. Estimated costs using 2005 dollars would be slightly different, but these earlier estimates are presented for comparison purposes.

All of the descriptions of the alternatives provide estimated groundwater cleanup times. The mathematical modeling of groundwater conducted by ERM predicted groundwater cleanup times for the alternatives which are presented here for the sake of comparison. That modeling effort was based on the best information available, however, as pointed out above, the groundwater conceptual model used as the basis for the modeling is an interpretation of Site conditions. Also pointed out above, USGS does not agree with some of the interpretation and, therefore, some of the conclusions. For the purposes of cleanup time estimation, the most significant disagreement is the importance of the fault zone. ERM describes the fault zone as a major conduit of groundwater in the area that functions as a driving feature for local groundwater flow. But USGS has represented the fault zone as only a coincidental feature, with the true driving force being the differences in transmissivity of the bedrock types in the area. In its review of the groundwater model used in the RI/FS, USGS was not tasked to conduct an alternate modeling exercise. However, a groundwater conceptual model based on the USGS Report, with

groundwater moving away from the Property in a wider flow path, would likely result in significantly longer cleanup predictions for the downgradient area analogous to Area C.

It remains important to remember that all groundwater modeling predictions are estimates, and the actual cleanup times may vary significantly from those presented in this ROD due to the limitations of modeling and interpretation, and unknowns or variations in the physical characteristics of the bedrock, groundwater and flow patterns.

Alternative 1: No Action

The No Action Alternative provides no specific actions to address Site contamination or risks aside from annual monitoring of groundwater conditions and Five-year Reviews. The contents of the Quarries and the contaminated soil areas of the Property would remain in their current condition. Long-term Monitoring and Five-year Reviews, as described above, are included in this alternative. It has been estimated that natural attenuation of contaminants contained on the Property would result in groundwater contaminant levels reaching acceptable levels in 229 years for Groundwater Area C and 234 years for Groundwater Area B

Capital Cost	$ 0
Present Worth O&M Cost	$ 310,000
Total Project Cost	$ 310,000

Alternative 2: Containment by Capping of the Quarries and Contaminated Soil Areas

This Alternative utilizes engineered caps to contain the contaminants on the Property and minimize the risks of direct contact and continued release of contamination to the underlying groundwater.

The surface of the main Property would be regraded as necessary to direct surface water away from the Quarries to reduce surface water accumulation. The remaining building foundation slabs would be removed, crushed or broken, and placed into the South Quarry, or other area of the Property, as fill. The existing waste water Equalization Basin would be drained, demolished and backfilled into the South Quarry.

Each contaminated soil area that has been determined to present unacceptable direct contact exposure risk or unacceptable groundwater contamination risk would be capped in its current location with either a low-permeability asphalt or geosynthetic cap. Example cross-sections of these types of caps are presented in Figure 6. Capping for these areas would be designed, as necessary, to prevent direct contact with the underlying soils and to prevent unacceptable leaching of contaminants from the soils into the groundwater.

The Quarries, with any additional consolidated fill materials, would be graded and capped with engineered multiple-layer caps at their existing elevations (the bottom of the depressions). Multiple-layer caps, such as asphalt or geosynthetic caps, are placed on waste to prevent direct contact and to minimize or eliminate infiltration of water into and through the waste. Layers may

include geosynthetic membranes or liners, compacted soils, clays and other structural and functional materials typically used for capping. Because the waste in the Quarries most resembles the definitions for Residual Waste, the caps would be designed to conform with Pennsylvania's Residual Waste Regulations. Alternative capping materials may also be considered, but any cap for the Quarries will be designed to comply with the performance requirements of Pennsylvania's regulations for a Residual Waste Landfill.

Because the caps would be installed in the existing Quarry depressions, accumulation of stormwater is anticipated. The Quarry caps would be shaped to produce perimeter drainage ditches and retention basins that would facilitate stormwater collection. An automated pumping system would also be installed at the base of the Quarries to remove the accumulated stormwater when it reaches a pre-determined level and discharge the water to the nearby tributary of West Valley Creek. Because of the steepness of some of the Quarries' side slopes, additional measures, such as the addition of support structures, would be taken to promote stability and proper surface water runoff.

Capping of the Quarries and other contaminated soil areas would prevent direct contact with the contaminated materials, and reduce and/or eliminate surface water moving through the materials and carrying contaminants into the groundwater. With the major sources of continuing contamination cut off, the natural flow of the groundwater would dilute the residual contamination in the existing groundwater plume. Residual contamination would be carried with the groundwater moving east-northeast, parallel to the fault zone (Groundwater Area C) where it would be diluted as it moves away from the Site. ERM's modeling of the groundwater indicates that the levels of lithium, boron and chromium in Groundwater Area C would start to decline almost immediately after capping is completed, with contaminant cleanup goals being achieved along the narrow fault zone from the Property boundary and all points downgradient in 16 years. Because it is subject to different groundwater flow conditions (smaller fractures, slower groundwater flow) it is estimated that Groundwater Area B, immediately adjacent to the Property, would take approximately 529 years to reach currently designated cleanup goals for lithium, boron and chromium.

Capital Cost	$ 2,353,000	
Present Worth O&M Cost	$ 472,420	
Total Project Cost	$ 2,830,000	(rounded)

Alternative 2a/2b: Containment by Consolidation and Capping of the Quarries at Surrounding Elevations
(This Alternative is a component of the Preferred Remedy proposed in the October 2005 Proposed Plan and selected in this ROD)

(Each part of Alternative 2a/2b was developed independently of the Feasibility Study Report in response to questions and discussions between EPA and the RI/FS Contractor, ERM. These additional communications are summarized and presented in the attachments to the June 5, 2001 cover letter provided with the June 5, 2001 Feasibility Study Report.) Alternative 2a/2b is a

single alternative requiring installation of impermeable caps on the Quarries. However, the description and costs for this alternative were estimated with two different examples of capping materials: for 2a, asphalt as the capping material is described, while 2b was developed with a multilayer geosynthetic cap.

Alternative 2a/2b includes the components of Alternative 2 with the following exceptions:

Instead of being capped in place, the direct contact risk and groundwater risk soils of the Main Plant Area would be excavated and consolidated into the Quarries. This consolidates all of the source materials under the Quarry caps, reducing the total number of caps and the associated maintenance costs.

Instead of capping the Quarries in the existing depressions, additional materials (consolidated fill from other areas of the Site and appropriate off-site clean fill materials) would be added to bring the Quarries to the elevations of the surrounding ground surface. The filled Quarries would then be graded and capped to promote surface drainage away from the Quarries. Bringing the elevation of the Quarries up to the level of the surroundings will eliminate the need for perimeter drainage ditches, detention basins and active pumping of collected stormwater. As described in Alternative 2, capping would prevent direct contact with the contaminated materials, reduce continuing contamination of the groundwater, and allow the residual contamination of the existing plume to dissipate. ERM's modeling estimates that cleanup goals for lithium, boron and chromium in groundwater would be achieved in the same time frame as Alternative 2.

Alternative 2a was developed with asphalt as the capping material for the Quarries. Alternative 2b was developed with a multilayer geosynthetic cap. Other capping materials may also be considered during design and construction, however, any cap for the Quarries will comply with Pennsylvania's regulations for a Residual Waste Landfill Cap.

<u>2a (asphalt cap)</u>		
Capital Cost	$ 3,391,700	
Present Worth O&M Cost	$ 433,420	
Total Project Cost	$ 3,830,000	(rounded)
<u>2b (geosynthetic cap)</u>		
Capital Cost	$ 3,580,200	
Present Worth O&M Cost	$ 433,420	
Total Project Cost	$ 4,010,000	(rounded)

Alternative 3: Containment by Capping and Subsurface Barrier

This Alternative is similar to Alternative 2 with the following differences:

Instead of being capped in place, the contents of the North Quarry and the direct contact risk soils of the Main Plant Area would be excavated and consolidated into the South Quarry. After

excavation, the areas of direct contact risk soils would be backfilled with clean fill, but the North Quarry would be left open to receive stormwater runoff which would then drain to recharge the groundwater. The groundwater risk soils of the Main Plant Area would be capped in their current locations as described in Alternative 2.

Additionally, a physical barrier wall would be installed within the perimeter of the South Quarry to the extent practical. The physical barrier is currently envisioned as a sheet piling wall installed between the walls of the South Quarry and the majority of the waste to enclose the waste and divert the flow path of groundwater around the waste materials. This action would minimize the amount of groundwater that flows laterally through the waste. The South Quarry would then be filled to the elevation of the surroundings and capped with an engineered geosynthetic cap to minimize stormwater moving through the waste. Alternative capping materials may also be considered, but any cap for the Quarry will be designed to comply with Pennsylvania's regulations for a Residual Waste Landfill.

As described in Alternative 2, capping would prevent direct contact with the contaminated materials, reduce continuing contamination of the groundwater, and allow the residual contamination to dissipate. The addition of a subsurface barrier would serve to further limit the migration of contaminants from the Quarry area into the groundwater resulting in a faster cleanup time for the residual contamination downgradient, but a longer cleanup time for the contamination close to the sources. ERM's modeling indicates that the contaminant level in Groundwater Area C would start to decline almost immediately after capping is completed, with cleanup goals for lithium, boron and chromium being achieved along the narrow fault zone from the Property boundary and all points downgradient in 13 years. Because it is subject to different groundwater flow conditions it is estimated that Groundwater Area B immediately adjacent to the Property would take approximately 2,500 years to reach cleanup goals for lithium, boron and chromium.

Capital Cost	$ 5,621,000
Present Worth O&M Cost	$ 453,000
Total Project Cost	$ 6,074,000

Alternative 4: Containment by Capping with Groundwater Recovery and Treatment

This Alternative includes all of the components of Alternative 2, but with the following addition:

In addition to the remedy components described in Alternative 2 above, Alternative 4 includes a groundwater recovery system composed of three recovery wells, and a treatment system to remove contaminants, followed by discharge of the treated water to West Valley Creek.

The groundwater recovery system would be designed to pump groundwater from points on the Property at a rate that would approximate the total flow of groundwater beneath the Property. Although final locations of the wells would be determined during detailed design, it is envisioned that one well would be located in the vicinity of the Quarries and the other two wells would be placed at locations in the Main Plant Area. Pumping of these wells would capture the

groundwater flowing beneath the source areas before it could leave the Property boundaries. The water would then be treated to remove the contaminants, and the treated water would then be discharged to West Valley Creek.

The recovered groundwater would be treated in a treatment plant constructed on the Property. The treatment was envisioned to be specific for four elements, lithium, boron, chromium and antimony; estimated treatment costs have been based on this assumption. Additional treatment for bromate is expected to increase the estimated cost. Final treatment requirements would be determined in the design of the treatment plant and are subject to the appropriate surface water discharge criteria of the National Pollutant Discharge Elimination System (NPDES). Recovery and treatment of the groundwater would continue until the residual contamination beneath the Foote facility reaches the groundwater cleanup goals.

As described in Alternative 2, capping would prevent direct contact with the contaminated materials, reduce continuing contamination of the groundwater, and allow the residual contamination to dissipate. The addition of the recovery and treatment system would serve to capture and remove residual contamination from the subsurface. ERM's modeling indicates that the contaminant level in Groundwater Area C would start to decline almost immediately after capping is completed, with cleanup goals being achieved along the narrow fault zone from the Property boundary and all points downgradient in 13 years. Because it is subject to different groundwater flow conditions it is estimated that Groundwater Area B, immediately adjacent to the Property, would take approximately 521 years to reach acceptable contaminant levels.

Capital Cost	$ 5,933,000	
Present Worth O&M Cost	$ 10,585,000	
Total Project Cost	$ 16,518,000	(rounded)

Alternative 5: Containment by Capping with Groundwater Diversion

This Alternative includes all of the components of Alternative 2, but with the following addition:

In addition to the remedy components described in Alternative 2 above, Alternative 5 includes a well for the recovery of uncontaminated groundwater from the far western side of the Foote facility and a well for the reinjection of that water a few hundred feet beyond the eastern Property boundary. Reinjection of the clean water at that location would redirect ("push") the natural groundwater flow immediately adjacent to the Quarries from northeast to north. This redirection of groundwater would serve to prevent the ongoing migration of contaminants to the properties east and northeast of the Foote facility (Groundwater Area B).

As described in Alternative 2, capping would prevent direct contact with the contaminated materials, reduce continuing contamination of the groundwater, and allow the residual contamination to be diluted and carried away. The added reinjection of clean water would increase the volume of clean water moving through the fractures, serving to flush the residual contaminants away from the properties east and northeast of the Property (Groundwater Area B) and into the groundwater trough surrounding the fault zone (Groundwater Area C) where it

would be further diluted. ERM's modeling indicates that the contaminant level in Groundwater Area C would start to decline almost immediately after capping is completed, with cleanup goals being achieved along the narrow fault zone from the Property boundary and all points downgradient in 16 years. That model also estimated that with the addition of reinjected clean water causing increased water flow in this area, Groundwater Area B would take approximately 10 years to reach acceptable contaminant levels. This predicted cleanup time for Area B is much shorter than the other Alternatives as a result of the theoretical flushing effect the reinjection well would have in this area; the reinjected clean water would flush the contaminants From Area B into the fault zone where they would be rapidly dispersed. However, it is important to consider that in the USGS interpretation of groundwater flow, the fault zone is not considered to be a major feature and would not be expected to have this dispersing effect. Under that interpretation it is likely that reinjected water would only serve to displace the contamination further to the north. But without the rapid dispersion, there would not be such a dramatic difference in cleanup time.

Capital Cost	$ 2,458,000
Present Worth O&M Cost	$ 705,000
Total Project Cost	$ 3,163,000

Alternative 6: Excavation and Off-Site Disposal

Unlike the previously described Alternatives which use capping to contain the contaminants on-Site, this Alternative requires the complete excavation and removal of all Quarry materials and contaminated soils, sediments, and debris deemed to pose potentially unacceptable risks.

Quarry materials would be excavated with large excavators and similar large volume earth moving equipment. The other impacted materials would be excavated with conventional equipment. Standing water would be drained from the Quarries prior to excavation and it is expected that continued dewatering would be necessary to facilitate the removal of deeper Quarry materials located below the water table.

Excavated materials would be sampled for waste classification prior to off-site disposal. Based on previous sampling of the Quarry materials it is anticipated that the materials would be classified as non-hazardous solid waste. Most of the materials would be loaded directly into roll-offs or dump trailers for transportation to an appropriate off-site landfill. However, an estimated 20 cubic yards of material is believed to be regulated by the Toxic Substances Control Act, 15 U.S. §§ 2601 - 2692, due to the presence of PCB contamination and would have to be disposed at a TSCA-approved facility.

Based on the volumes estimated during the Remedial Investigation, the off-site disposal would require approximately 22,000 trucks over the course of one to two years, assuming 20-ton capacity trucks and 50 to 100 trucks per day maximum traffic.

Excavation and removal of all impacted materials would prevent direct contact with contaminated materials and eliminate the continuing contamination of the groundwater. The

residual contamination would then be diluted by the infiltration of surface water and carried away by the natural flow of groundwater in the subsurface. ERM's modeling has indicated that the contaminant level in Groundwater Area C would start to decline almost immediately after removal is completed, with estimated time for lithium, boron and chromium cleanup goals to be achieved along the narrow fault zone from the Property boundary and all points downgradient in 13 years. Because it is subject to different groundwater flow conditions, it is estimated that Groundwater Area B immediately adjacent to the Property would take approximately 18 years to reach acceptable contaminant levels.

Capital Cost	$ 45,072,000
Present Worth O&M Cost	$ 196,000
Total Project Cost	$ 45,268,000

Alternative 7: Phased Approach: Consolidation and Capping of the Quarries.

This Alternative was proposed as EPA's Preferred Alternative in the August 2003 Proposed Plan, which was subsequently retracted. This Alternative was developed, after the Feasibility Study Report was finalized, in response to the discovery of bromate. The approach to addressing Operable Unit 1 alone, as a final remedy alternative, was developed in the 20 September 2002 Feasibility Study Amendment for Operable Unit OU-1. The presumptive remedy for Operable Unit 2 was proposed to be implemented following the conclusion of additional bromate studies as a second phase to the remedy. This Alternative was proposed to the public as EPA's Preferred Alternative in the August 2003 Proposed Plan, but was later retracted following the discovery of low level radiation at the Site. The additional bromate studies have been completed and indicate that bromate will behave similarly to the other chemical contaminants encountered at this Site, eliminating the need for a phased approach, making this Alternative identical to Alternative 2a/2b. Therefore there will be no further analysis or consideration of Alternative 7.

SUMMARY OF ALTERNATIVE AMENDMENTS

Following the release and subsequent retraction of the August 2003 Proposed Remedial Action Plan, two additional Feasibility Study Amendment Reports were submitted to EPA. These reports summarized the additional studies conducted at the Site, and developed and evaluated additional remedial alternative components (Alternative Amendments). The three Alternative Amendments that follow are not complete alternatives. They were developed, and are presented here, to be considered as enhancements to the original alternatives presented in the August 2003 Proposed Plan. Other potential amendments were screened out of consideration in the Feasibility Study Amendment Reports. The Alternative Amendments are summarized in Table V below.

TABLE V
SUMMARY OF MAJOR COMPONENTS OF ALTERNATIVE AMENDMENTS

	ALTERNATIVE AMENDMENT	KEY COMPONENTS OF AMENDMENT
1	**Containment in the North Quarry for the Radiologically-impacted Soils**	• The six areas of radiologically-impacted soils would be excavated to a depth of approximately two feet or until background conditions are reached. • The excavated soils would be moved into the North Quarry and covered with at least six feet of fill or cover materials during the capping of the Quarry
2	**Excavation and Off-site Disposal for the Radiologically-impacted Soils**	**(This Alternative Amendment is a component of the Preferred Remedy proposed in the October 2005 Proposed Plan and selected in this ROD)** • The six areas of radiologically-impacted soils would be excavated to a depth of approximately two feet or until background conditions are reached. • The excavated soils would be removed and disposed off-site.
3	**In-Situ Soil Stabilization of the Waste in the South Quarry**	**(This Alternative Amendment is a component of the Preferred Remedy proposed in the October 2005 Proposed Plan and selected in this ROD)** • The waste material in the South Quarry below the seasonal high bedrock groundwater level would be stabilized with cement and/or other appropriate reagents to form solidified columns of concrete-like material ("soilcrete"). • The stabilized material would have reduced permeability and resist the flow of groundwater through the waste material.

Alternative Amendment 1: Containment in the North Quarry for the Radiologically-Impacted Soils

Originally described as Alternative 3 in FS Amendment 2, this amendment includes the excavation, consolidation and containment in the North Quarry for the radiologically-impacted soils. The six areas of soil that presented above-background radiation levels during the surface radiation survey would be excavated to the depth where background levels were encountered; expected to be two feet in most areas. The ambient background level during the survey was determined to be 12.2 micro roentgens per hour (μR/hour). Together the six areas have been estimated to cover approximately 12,217 square feet in surface area. And the anticipated volume of radiologically-impacted soils is 904 cubic yards. The excavated soils would be consolidated in the North Quarry and covered to a depth of at least six feet to minimize future exposure and reduce the potential risk to below 1.0E-6. This Alternative Amendment was developed with the assumption that the North Quarry would be permanently capped as part of the final remedy. Therefore the costs involved with capping and future operation and maintenance are not included here.

Capital Cost	$ 11,300
Present Worth O&M Cost	$ 0
Total Project Cost	$ 11,300

Alternative Amendment 2: Excavation and Off-Site Disposal of the Radiologically-Impacted Soils
(This Alternative Amendment is a component of the Preferred Remedy proposed in the October 2005 Proposed Plan and selected in this ROD)

Originally described as Alternative 4 in FS Amendment 2, this amendment includes the excavation, transport and off-site disposal of the radiologically-impacted soils. The six areas of soil that presented above-background radiation levels during the surface radiation survey would be excavated to the depth where background levels were encountered (depth of two feet in most areas). The ambient background level during the survey was determined to be 12.2 micro roentgens per hour (μR/hour). Together the six areas have been estimated to cover approximately 12,217 square feet in surface area. And the anticipated volume of radiologically-impacted soils is 904 cubic yards. The excavated soils would be loaded into trucks and transported to an appropriate off-site landfill permitted to accept these soils.

Capital Cost	$ 684,000
Present Worth O&M Cost	$ 0
Total Project Cost	$ 684,000

Alternative Amendment 3: In-Situ Soil Stabilization of the Waste in the South Quarry
(This Alternative Amendment is a component of the Preferred Remedy proposed in the October 2005 Proposed Plan and selected in this ROD)

Originally described as a component of Modified Alternative No. 2a/2b in FS Amendment 3, this amendment consists of mixing cement and/or other additives into the waste process tailings contained in the South Quarry to create overlapping solid columns of mixed "soilcrete" within the surrounding bedrock of the Quarry walls. The resulting stabilized mass of tailings would be expected to be 10 to 100 times less permeable than the tailings in their current condition causing an equivalent reduction in contamination leaving the waste. The physical mixing and the introduction of stabilizing additives is produced by large (six foot or twelve foot diameter) single or multi-auger systems. In general, columns are produced by first augering down through the waste mass and then mixing the additives with the waste from the bottom up as the augers are rotated and retracted. The augers are then moved to new locations and the process repeated until the target area is covered. The overlapping stabilized soil columns cure to form a single monolithic concrete-like mass.

This Alternative Amendment was developed as part of an alternative that included capping of the South Quarry after stabilization of the waste. Consequently, it is envisioned that only the waste

mass that is in contact with the groundwater would be stabilized. This would be the portion of the waste that is situated below the seasonal high water table for the Quarry area. The waste that is above the water table would not be stabilized. The estimates of the water level and the corresponding waste volume will be finalized in the Remedial Design, however the USGS calculated the long-term average saturated thickness of the waste (average water level in the waste) to be 11.1 feet in the South Quarry and the Feasibility Study Amendment 2 used a value of 15 feet of waste across the South Quarry for cost estimation.

It is also contemplated that this technology may be able to construct a combination of vertical and horizontal barriers along the perimeter sidewalls and floor of the Quarry to produce a containment structure ("bathtub") with a level of performance equivalent to that achievable with construction of a monolith. A containment structure shown to achieve comparable performance would be considered an acceptable alternate to construction of a monolith. The final design parameters for implementation of this technology, including appropriate thickness of waste to be treated, water level, specific chemical additives and physical configuration of the in-situ soil stabilization effort, would be based on information developed in the pre-design studies. Also as discussed in Feasibility Study Amendment No. 3, implementation of this Alternative Amendment may be supplemented, where necessary, by jet grouting of localized areas around irregularities and the side walls where the smaller diameter jet grouting augurs would be more effective.

Capital Cost	$ 9,238,000	(this is the increase over Alternative 2b)
Present Worth O&M Cost	$ 0	
Total Project Cost	$ 9,238,000	

X. SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

Criteria Used To Compare Cleanup Alternatives

The remedial alternatives and alternative amendments summarized in this Record of Decision have been evaluated against the nine decision criteria set forth in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 C.F.R. § 300.430(e)(9)). These nine criteria are organized into three categories: threshold criteria, primary balancing criteria and modifying criteria. Threshold criteria must be satisfied in order for an alternative to be eligible for selection. Primary balancing criteria are used to weigh major trade-offs between alternatives. Modifying criteria are formally taken into account after public comment has been received. The criteria, as well as the evaluation of each alternative against such criteria, are set forth below:

Threshold Criteria

1. Overall Protectiveness of Human Health and the Environment assesses whether an alternative eliminates, reduces, or controls threats to public health and the environment through treatment, engineering controls, or institutional controls.

2. Compliance with Applicable or Relevant and Appropriate Requirements (ARARs) evaluates whether the alternative meets all of the applicable, or relevant and appropriate, requirements of Federal and State environmental statutes and regulations and/or whether there are grounds for invoking a waiver.

Primary Balancing Criteria

3. Long-Term Effectiveness and Permanence considers the ability of an alternative to maintain protection of human health and the environment over time once cleanup goals are achieved.

4. Reduction of Toxicity, Mobility, or Volume of Contaminants Through Treatment evaluates the degree to which treatment will be used to reduce the toxicity, mobility, or volume of contaminants causing site risks.

5. Short-Term Effectiveness considers the length of time needed to implement an alternative and the risks the alternative poses to workers, residents, and the environment during implementation.

6. Implementability considers the technical and administrative feasibility of implementing the alternative, including factors such as the relative availability of materials and services.

7. Cost includes estimated capital and annual operations and maintenance costs, as well as present worth cost. Present worth cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50 to -30 percent.

Modifying Criteria

8. State/Support Agency Acceptance considers whether, based on its review of backup documents and the Proposed Plan, the State concurs with, opposes, or has no comment on the remedy selected by the EPA.

9. Community Acceptance considers whether the local community agrees with the remedy proposed by EPA during the comment period. This criteria is assessed in the Record of Decision following a review of public comments received on the Proposed Plan.

Comparative Evaluation

The following evaluation presents the comparison of the original Alternatives as they were presented before the discovery of low-level radiation at the Site. The Alternative Amendments developed in the studies following the discovery of radiation are not complete alternatives. They are presented and evaluated here as enhancements to the original Alternatives. The original Alternatives did not discuss or address the handling of the radiologically impacted soils and did not evaluate the possibility of in-situ soil stabilization of the South Quarry waste. However, the Alternative Amendments are designed to focus on and address the condition these specific characteristics of the Site.

The Alternative Amendments are evaluated independently of the original Alternatives because they add very similar benefits to each of the original Alternatives except Alternative 1, No Action, which by definition could not incorporate any Amendments and Alternative 6, Excavation and Off-Site Disposal, for which the Amendments would not be appropriate.

1. Overall Protection of Human Health and the Environment

A primary requirement of the NCP is that the selected remedial alternative be protective of human health and the environment. A remedy is protective if it reduces current and potential risks to acceptable levels under the established risk range posed by each exposure pathway at the Site.

With the exception of Alternative 1 (No Action) which is not protective, EPA has determined that each Alternative would provide protection from unacceptable direct contact exposure risks rapidly, over the one- to two-year time frame required for construction. Each Alternative, except Alternative 1, would also reduce the levels of contaminants migrating away from the Property to acceptable levels, but under varying time frames. For the sake of comparison of the alternatives, cleanup times predicted by ERM's groundwater model are presented here. It is important to note that predictions from groundwater models are based on the best available information, but they are still estimates. It is also important to note that USGS disagrees with some of the interpretations used in ERM's model. USGS' analysis anticipates slower groundwater movement in the downgradient area analogous to Groundwater Area C. Consequently, using USGS' interpretations the estimates for cleanup times for Area C could be significantly longer. During the remedy selection process, EPA considered the common elements in both ERM's and USGS' groundwater interpretations and also evaluated the disagreement and subsequent uncertainty in the predicted cleanup times.

Using ERM's groundwater model to predict clean-up times for the downgradient area (Groundwater Area C) indicates that for Alternatives 2 through 6 the groundwater concentrations can reach the preliminary remediation goals (PRGs as specified in Section VI, Table III) within 12 to 16 years as opposed to 229 years required for Alternative 1.

Alternatives 2 through 5 achieve overall protection of human health and the environment by containing the affected media under engineered caps which would minimize the infiltration and contamination of surface water moving through the waste. Alternative 6 achieves this through the complete removal of impacted soils and Quarry materials.

Alternative 3 includes an additional measure (subsurface barrier) to reduce contaminants migrating into the groundwater, although it is only a minor reduction - a theoretical 3% reduction over Alternative 2.

Alternatives 2 through 6 pursue institutional controls to prevent residential use of the capped areas and preserve the integrity of the remedial actions. Institutional controls may include deed notices, restrictive covenants, and/or other appropriate legal instruments to deter or prevent future residential development. Alternatives 2 through 6 also pursue institutional controls for the former Property to prevent the installation and use of untreated groundwater wells for drinking

water purposes. Also, a groundwater management zone extending downgradient from the Property will be developed to mitigate the risk of contaminated groundwater being used for consumption.

Alternatives 2a/2b, 3, and 6 present the greatest short-term risks of exposure and injury to on-Site workers because of the greater degree of waste handling (excavation) and heavy equipment required. Alternative 6 requires the most waste handling and introduces further additional risk due to the increased truck traffic for the off-site disposal and the potential for off-site releases due to accidental spills of material.

Alternative Amendments 1 and 2 minimize the potential for direct exposure to the radiologically-impacted soils by removing them from the surface. Additionally, Alternative Amendment 2 transports those soils to a certified disposal area with appropriate long-term operation and maintenance.

Alternative Amendment 3 uses in-situ soil stabilization technology to stabilize and reduce the permeability of the waste materials in the South Quarry that would otherwise remain in direct contact with the groundwater. This technology would add an additional level of protectiveness by minimizing the ability of contamination to leach out of the materials currently in contact with the groundwater and address the uncertainties in the prediction of the future downgradient groundwater conditions.

2. Compliance with Applicable and Relevant and Appropriate Requirements (ARARs)

Unless there is valid justification for an appropriate waiver, any cleanup alternative considered by EPA must comply with all applicable or relevant and appropriate federal and state environmental requirements. Applicable requirements are those substantive environmental standards, requirements, criteria, or limitations promulgated under federal or state law that are legally applicable to the remedial action to be implemented at the Site. Relevant and appropriate requirements, while not being directly applicable, address problems or situations sufficiently similar to those encountered at the Site. ARARs may relate to the substances addressed by the remedial action (chemical specific), to the location of the site (location specific), or to the manner in which the remedial action is implemented (action specific).

Major ARARs for the groundwater remedies listed in this ROD include: Federal Maximum Contaminant Levels (MCLs) and/or Maximum Contaminant Level Goals (MCLGs) for drinking water established under the Safe Drinking Water Act 42 U.S.C. §§300g-l; the Pennsylvania National Pollutant Discharge Elimination System (NPDES) program requirements; 25 PA Code Chapters 95.1 - 95.3; Section 402 of the Clean Water Act for surface water discharges; and 40 CFR 131 (compliance with established water quality standards).

Earth moving activities in the Alternatives 2 through 6 would be conducted in compliance with 25 PA Code Chapter 102, requiring the planning and implementation of appropriate erosion and sedimentation controls. Alternatives 2 through 5 would need to meet the substantive requirements for Residual Waste Landfill caps found at 25 PA Code Chapter 288. To the extentnecessary, excavated materials from the Quarries and plant areas would be sampled to

determine the appropriate disposal method.

Because of the above-background levels of radioactivity found in soil and the concentrations of radium and thorium, the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA) may be Relevant and Appropriate. In Alternative Amendment 1 the radiologically-impacted soils would be consolidated into the North Quarry which may trigger the disposal and specific cap requirements of UMTRCA. In Alternative Amendment 2, soils from the six radiologically-impacted areas will be sampled, characterized and transported to an appropriately permitted off-site facility for disposal.

Because of its inability to prevent direct contact exposure risks and unacceptable contaminant levels in groundwater, Alternative 1 does not comply with ARARs. Alternatives 2 through 6 can be designed to comply with ARARs. Erosion and sedimentation controls for all excavation and earth moving activities are easily implemented, as they are standard and easily achieved work practices. All capping alternatives can be designed to meet the substantive legal requirements for construction and performance of Residual Waste Caps. Treatment technologies can be designed and used to treat extracted water to the levels necessary to meet NPDES permitted discharge to surface water. Under Alternatives 2 through 6, contaminant levels in the groundwater will diminish in a relatively short time period and meet the appropriate MCLs, water quality standards and/or PRGs in downgradient Groundwater Area C. Institutional controls can be implemented to prevent the use of groundwater in Area C until the water quality meets these standards. Institutional controls can be implemented to prevent the use of groundwater and exposure to contaminants in Groundwater Areas A and B until water quality standards are met.

Alternative Amendment 3 would not trigger additional ARARs.

3. Long-Term Effectiveness and Permanence

Contaminants left on-Site will be managed and will present no unacceptable long-term risks in any of the Alternatives except Alternative 1, No Action. Alternative 1 does not provide any degree of long-term protectiveness because it does not address potential risks.

Alternatives 2 through 5 utilize engineered containment and institutional controls to provide long-term protectiveness from direct contact exposure to contaminated materials and to reduce the levels of contaminants in the groundwater to the cleanup goals. The engineering controls (capping and extraction or redirection of groundwater) considered in these Alternatives are established and reliable technologies for continued performance. Alternatives 2 through 5 also include periodic monitoring to verify the long-term effectiveness.

Alternative 6 reduces risks by excavation and removal of contaminated materials from the Foote Facility, but would shift the responsibility for long-term management to the off-site disposal facility that receives the waste.

In Alternatives 2a/2b and 3 consolidation of the waste materials gives the advantages of limiting the surface area that will require long-term maintenance, and allowing the Main Plant Area to be redeveloped with fewer restrictions.

On-Site disposal of the radiologically-impacted soils as described in Alternative Amendment 1 may trigger more stringent requirements for cap design and the long-term maintenance program to ensure the long-term effectiveness and permanence of the remedy. Under Alternative Amendment 2, the soils would be disposed in a facility already meeting the appropriate requirements.

Alternative Amendment 3 increases the long-term effectiveness of the capping alternatives. By stabilizing the waste, the uncertainties associated with the continued contact between the groundwater and the bottom portion of the waste in the South Quarry are reduced.

4. Reduction of Toxicity, Mobility or Volume by Treatment

Alternative 1 provides no immediate reduction in Toxicity, Mobility or Volume (TMV) of contaminants.

Alternatives 2 though 6 provide small reduction of TMV through the passive recovery of LNAPL at Monitoring Well 2.

Alternatives 2 through 6 do not treat the majority of the waste; protectiveness is accomplished by containment, either on-site or off-site. These Alternatives do, however provide for a reduction in toxicity and volume of contaminants in the groundwater as the plume diminishes over time, following the containment of the source materials. Alternative 4 provides significant reduction in TMV by treatment of the recovered groundwater.

Alternative Amendments 1 and 2 do not treat the radiologically-impacted soils; protectiveness is accomplished by containment either on or off-site. However, because they are primarily surface soils that are subject to erosion, containment will reduce their mobility.

By stabilizing the waste in the South Quarry, Alternative Amendment 3 would reduce the mobility of the contaminants by treatment.

5. Short-Term Effectiveness

Alternative 1 is not effective in the short term because it does not address the existing direct contact and groundwater contamination.

Alternatives 2 through 5 provide a high degree of short-term effectiveness because they rapidly address the direct contact risks with the engineering controls (capping). Alternative 6 also provides rapid control of existing risks, but introduces the most new short-term risks, as described below. By capping, or consolidating and capping, the source areas on the Site these Alternatives also provide a rapid reduction in the release of contaminants to groundwater. Further protectiveness is provided by the institutional controls on the Property and the groundwater management zone which will prevent consumption of the groundwater until the cleanup goals are established.

The consolidation Alternatives, 2a/2b and 3, introduce short-term, on-site worker risks due to excavation and consolidation of waste materials from the Main Plant Area into the Quarries. These short-term risks can be mitigated with appropriate safety precautions (e.g., dust control, erosion control, a comprehensive health and safety plan) implemented during the active construction phase. Alternative 6 introduces the most significant short-term risks because it involves the most disturbance of the wastes and the longest period of construction activity. It is the only Alternative that involves significant off-site transportation of wastes which introduces additional risks to the surrounding community through increased truck traffic and the potential for accidents and spillage of waste.

The times estimated by ERM's groundwater modeling for cleanup goals (Preliminary Remediation Goals, or PRGs, described in Section VII above) to be achieved in the groundwater in downgradient groundwater Area C are similar for Alternatives 2 through 6: Alternatives 2, 2a/2b and 5 have been estimated to take 16 years, Alternatives 3, 4 and 6 have been estimated to take 13 years. In Alternative 1, because no actions are taken to minimize contamination leaving the Property, modeling estimates that cleanup goals would not be achieved in Area C for 229 years. It is important to note that USGS disagrees with some of the interpretations used in ERM's model and therefore the predicted timeframes are subject to uncertainty.

In the groundwater flow interpretation presented by ERM, Groundwater Area B is generally expected to take longer to reach cleanup goals due to different groundwater flow conditions (smaller fractures, slower groundwater flow) - for Alternatives 1 through 4, in the hundreds of years. The 10 year cleanup time predicted for Area B under Alternative 5 is much shorter than the other Alternatives as a result of the theoretical flushing effect the reinjection well would have in this area; contaminants in area B would be flushed into the fault zone where they would be rapidly dispersed. However, it is important to consider that USGS interpretation of local groundwater flow disagrees with ERM's characterization of the fault zone as a major feature and would therefore not predict this dispersing effect. Using USGS' interpretation it is possible that reinjected water would only serve to displace the contamination in Area B further to the north without the dramatic reduction in time compared to the other alternatives. Finally, because all source areas would be removed in Alternative 6, cleanup time for Area B was estimated at 16 years for that alternative.

Under all Alternatives, it will take longer to reach the cleanup goals in groundwater Areas A and B, however public water is currently available in Area B, and there are no known wells currently being used for drinking water in Areas A or B. It remains important to remember that all groundwater modeling predictions are estimates, and that actual cleanup times may vary significantly from those presented in this ROD due to the limitations of modeling and interpretation, and unknowns or variations in the physical characteristics of the bedrock, groundwater and flow patterns. During the remedy selection process, EPA considered the disagreement in groundwater interpretations and subsequent uncertainty in the predicted cleanup times.

Alternative Amendments 1 and 2 add significantly to short-term effectiveness of the original alternatives because they rapidly contain the radiologically-impacted soils with engineering controls (capping) either on-site or off-site.

Alternative Amendment 3 is expected to improve the short-term effectiveness of the capping remedies by rapidly stabilizing the waste in the South Quarry. This will quickly reduce the ability of the contaminants to enter the groundwater even before the cap would be constructed. Although in-situ soil stabilization of the waste in the South Quarry has not been modeled, stabilization is anticipated to produce a reduction in groundwater contamination similar to excavation and removal.

6. Implementability

Alternative 1 is easily implementable but affords no protection. The construction methods and materials required for the capping components of Alternatives 2 through 5 are conventional and readily available. The construction effort required for waste consolidation in Alternative 2a/2b involves conventional earth moving and site development methods and equipment which are readily available. Alternative 3 involves significantly increased waste excavation due to the total removal of materials from the North Quarry. Alternative 6 involves the most waste excavation due to the total removal of soils and materials from all contaminated areas and both Quarries. Alternative 6 is also the most difficult to implement due to the amount of waste to be handled and shipped off-site, and the necessity of working in the South Quarry, which would involve excavation below the level of the water table.

Alternative 3 involves the installation of a deep subsurface barrier in unfavorable conditions, as well as the complete removal and relocation of materials and debris from the North Quarry. The installation of the subsurface barrier into the deep waste may encounter hidden obstacles, such as irregularities in the waste or the walls of the Quarry, that could compromise the installation or final effectiveness of the structure. This is a significant concern because of the limited additional benefit of a barrier. It is estimated in the FS that a fully effective barrier will only produce an additional 3 percent decrease in contaminant migration.

For Alternative 4, physical construction of groundwater extraction wells is straightforward. However, since the Site is located in an area of fractured dolomitic bedrock, it can be difficult to determine well locations that can effectively capture all contaminated groundwater from the targeted area. The treatment of lithium, boron, chromium and antimony, which would be necessary for the water recovered under Alternative 4, involves designing a treatment train for these four elements and other parameters (e.g. hardness, pH, particulates) that would affect the treatment efficiency. However, full-scale successful treatment for these elements has not been demonstrated to be effective since there is currently no available example of a successful similar application. Additional treatment for bromate would further complicate design and operation of the treatment train.

Alternative 5 would require obtaining access to adjacent properties for installation, operation and monitoring of the injection well and associated piping. Alternative 5 would also be complicated by the area's fractured bedrock, adding uncertainty to the effectiveness of the injection well.

A factor that could complicate the implementation of the remedy selected for this Site is the potential need for developing and implementing restrictions on groundwater usage on adjacent properties in the groundwater management zone, and the development of a representative

sampling program that will ensure safety in the downgradient areas east of the Foote facility. However, this is common to all Alternatives except Alternative 1.

Alternative Amendment 1, as originally presented, is an additional component of consolidation and capping, and most of the radiologically-impacted soils were targeted for consolidation as part the original alternative. The additional work would involve minimal additional earth moving with slightly increased precautions. Alternative Amendment 2 would require that the soils be segregated and shipped off-site. The earth moving and shipping required for these options are conventional operations and readily available, especially considering the relatively small volume of impacted soils. Alternative Amendment 3 requires the use of specialized equipment for the auguring and mixing of the waste with stabilizing additives, however the recent Feasibility Study Amendments and ongoing pre-design work for this Site indicates that the equipment is available and the technology is well understood and adaptable to the conditions specific to this Site.

7. Cost

The total estimated present worth cost for each alternative includes the initial capital costs, and an assumed 30-year Operation & Maintenance period. To evaluate the cost of the Alternatives on a present worth basis, the long-term O&M costs are discounted at a 5% discount rate and a standard 30% contingency is applied to the entire project. A summary of the total estimated present worth cost (in 2001 dollars) for each Alternative is presented below

Alternative 1 -	No Action	$310,000
Alternative 2 -	Containment by Capping of Quarries and Contaminated Soil Areas	$2,830,000
Alternative 2a - (Asphalt)	Containment by Consolidation, Capping of the Quarries at Surrounding Elevations	$3,830,000
Alternative 2b - (Geosynthetic)	Containment by Consolidation, Capping of the Quarries at Surrounding Elevations	$4,010,000
Alternative 3 -	Containment by Capping and Subsurface Barrier Wall	$6,074,000
Alternative 4 -	Containment by Capping, Groundwater Recovery and Treatment	$16,518,000
Alternative 5 -	Containment by Capping, Groundwater Diversion	$3,163,000
Alternative 6 -	Excavation and Off-Site Disposal	$45,268,000
Alternative Amendment 1 -	Containment in the North Quarry for the Radiologically-Impacted Soils	$ 11,300

Alternative Amendment 2 -	Excavation and Off-Site Disposal of the Radiologically-Impacted Soils	$684,000
Alternative Amendment 3 -	In-Situ Soil Stabilization of the Waste in the South Quarry	$9,238,000

8. State Acceptance

The Commonwealth of Pennsylvania supports the selection of Alternative 2b with Alternative Amendments 2 and 3: Consolidation and Capping of the Quarries at Surrounding Elevation, with Excavation and Off-site Disposal for the Radiologically -Impacted Soils, and In-situ Soil Stabilization of the South Quarry Waste.

9. Community Acceptance

EPA's Proposed Remedial Action Plan for the Foote Mineral Co, Superfund Site was released to the public on October 12, 2005 initiating a 30-day public comment period. In response to requests from the community, the public comment period was extended an additional 30 days and expired on December 11, 2005. During the comment period, on October 27, 2005, an advertised public meeting was held at the East Whiteland Township Building. In the meeting EPA staff presented an overview of the events that had occurred at the Site, described how the Superfund cleanup program works, described the remedial alternatives, and explained why EPA was recommending the preferred alternative. Following this presentation, EPA answered questions from the citizens regarding the Site and the proposed cleanup. A copy of the written transcript of the public meeting is available in the Administrative Record for this site.

Questions, comments, and concerns received during the public meeting and throughout the public comment period have been categorized and summarized in the Responsiveness Summary attached to this Record of Decision. Each comment is followed by EPA's response.

XI. PRINCIPAL THREAT WASTES

The NCP establishes an expectation that EPA will use treatment to address the principal threats posed by a site wherever practicable (40 C.F.R. §300.430 (a)(1)(iii)(A)). The "principal threat" concept is applied to the characterization of "source materials" at a Superfund site. A source material is material that includes or contains hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination to ground water, surface water or air, or acts as a source for direct exposure. Contaminated ground water generally is not considered to be a source material.

Principal threat wastes are those materials considered to be highly toxic or highly mobile that generally cannot be reliably contained, or would present a significant risk to human health or the environment should exposure occur. EPA has not identified any principal threat wastes at this Site.

XII. SELECTED REMEDY

Following consideration of the requirements of CERCLA, a detailed analysis of the alternatives using the nine criteria set forth in the NCP, and careful review of public comments, EPA has selected **Consolidation and Capping of the Quarries at Surrounding Elevations, Excavation and Off-site Disposal of the Radiologically-impacted Soils, In-situ Soil Stabilization of South Quarry Waste, Long-Term Monitoring of Groundwater, Removal of LNAPL from MW-2 and Institutional Controls (Selected Remedy).**

This remedy was presented to the public in the October 2005 Proposed Remedial Action Plan as Alternative 2b with Alternative Amendments 2 and 3. The total estimated present worth cost for all the components of the Selected Remedy is $13,936,000 (rounded). This remedy requires:

1) ***Radiological Soils:*** To prevent direct contact with radiologically contaminated soils, the soils will be excavated and shipped off-site for disposal at an appropriately permitted facility.

2) ***In-Situ Stabilization of the South Quarry Waste:*** The South Quarry waste will be stabilized using an in-situ soil stabilization technology to reduce contaminant migration to groundwater.

3) ***Soils, Waste Material, and Debris Consolidation:*** To prevent direct contact with contaminated soils on the Property and reduce contaminant migration to groundwater, contaminated soils will be excavated and consolidated in either the North or South Quarry. In addition, other waste materials, debris, or demolition waste may also be consolidated and placed into the Quarries prior to final capping.

4) ***Capping of the North and South Quarry:*** The Quarries will be capped to reduce contaminant migration from the waste in the Quarries to the groundwater.

5) ***Long-term monitoring of the Groundwater:*** Monitoring of groundwater will be conducted to determine if the above source control measures are effective in reducing contaminant concentrations in groundwater to drinking water standards.

6) ***Removal of LNAPL from groundwater in MW-2:*** LNAPL will be removed to prevent its migration into the groundwater

7) ***Institutional Controls:*** Institutional controls shall be implemented to prevent residential use of impacted groundwater, prevent residential use of the capped Quarry areas and preserve the integrity of the remedy.

This remedy will meet the cleanup objective by minimizing or eliminating the risk of the direct contact with contaminated materials, minimizing the leaching of contamination to groundwater and returning the six areas of radiologically contaminated soils to background levels. Further, the institution of a groundwater management zone will minimize the potential for exposure to contamination by restricting the installation of new wells in contaminated groundwater.

Summary of the Rationale for the Selected Remedy

Numerous benefits are gained with the components of this remedy. The components of the Selected Remedy will mitigate the unacceptable potential risks to human health and the environment that currently exist at the Site and all activities required in the Selected Remedy can be designed and implemented to meet ARARs. Excavation and off-site disposal of the radiation contaminated soils removes the risk of long-term exposure to those materials and eliminates uncertainty in the handling and proper disposal of those materials. Consolidation of waste materials and capping of large volume wastes are established remedial technologies that utilize conventional earth moving and site development methods and equipment which are readily available. Consolidation of the site waste in the Quarries also serves to minimize the number of caps and necessary future maintenance while maximizing the Property that will be made available for reuse.

Capping of all the site wastes will minimize the continued migration of contaminants to the groundwater and allow the existing groundwater plume to dissipate. Additionally, the stabilization of the materials in the South Quarry prior to capping will further reduce the potential for contaminant migration to the groundwater by significantly lowering the permeability of the waste materials that will remain in contact with the groundwater.

Filling the Quarries and capping at the surrounding ground surface will allow the caps to be graded to promote passive surface drainage away from the Quarries.

Based on available information, EPA believes the Selected Remedy meets the threshold criteria and provides the best balance of tradeoffs among the other alternatives with respect to the balancing and modifying criteria. EPA expects the selected alternative will satisfy the requirements of section 121(b) of CERCLA, 42 U.S.C. § 9621(b), by:

- Being protective of human health and the environment;
- Complying with ARARs;
- Utilizing permanent solutions and alternative treatment technologies to the maximum extent practicable;
- Satisfying the preference for treatment as a principal element; and
- Being cost effective.

Description of the Selected Remedy and Performance Standards

The Selected Remedy requires the following activities.

1. Radiological Soils

All radiologically-impacted soils present on Site will be excavated, transported and disposed off-site at an appropriately permitted disposal facility. The six areas of soil that have been identified to contain above-background radiation levels during the surface radiation survey will be excavated. Excavation will continue until background levels for radionuclides are achieved. These cleanup levels are presented in Table R-1. The six areas have been estimated to cover

approximately 12,217 square feet in surface area. And the anticipated volume of radiologically-impacted soils is 904 cubic yards. The excavated soils will be loaded into trucks and transported to an appropriate off-site landfill permitted to accept these soils.

Following excavation, confirmation soil samples will be collected and analyzed from the excavation areas will analyzed for the radionuclides presented in Table R-1. Confirmation sampling will be conducted in accordance with a sampling plan to be approved by EPA during the Remedial Design.

2. **In-Situ Stabilization of South Quarry Waste**

In-Situ Soil Stabilization will be performed on the volume of waste in the South Quarry that may come in contact with the groundwater. This volume is defined as the portion of waste that is located below the seasonal high water table for the South Quarry. The waste that is above the water table will not require stabilization. The estimates of the seasonal high water table and the corresponding volume of waste to be stabilized will be refined and finalized in the Remedial Design.

The waste shall be stabilized using cement and/or other additives that will be mixed into the waste process tailings contained in the South Quarry to create overlapping solid columns of mixed "soilcrete" within the surrounding bedrock of the South Quarry walls. The resulting stabilized mass of tailings is expected to be significantly less permeable than the tailings in their current condition causing an equivalent reduction in contamination leaving the waste. Design studies will be conducted to determine the type and proportions of stabilizing additives that will minimize the permeability of the treated mass. It is anticipated that, with the appropriate additives, the treated permeability can be reduced to 1.0×10^{-6} centimeters per second or lower. The physical mixing and the introduction of stabilizing additives will be produced by large (six foot or twelve foot diameter) single or multi-auger systems. In general, columns are produced by first auguring down through the waste mass and then mixing the additives with the waste from the bottom up as the augers are rotated and retracted. The augers are then moved to new locations and the process repeated until the target area is covered. The overlapping stabilized soil columns cure to form a single monolithic concrete-like mass.

The appropriate additives to be used for stabilization and the specific details of the stabilization process will be determined during the Remedial Design.

3. **Soils, Waste Material and Debris Consolidation**

All soils in the areas identified in Table II of this ROD (Section VII. A.) as direct contact risk soil areas and/or groundwater risk soil areas shall be excavated and consolidated into either the North or South Quarry. Soils shall be excavated to the extent where the contaminant levels in the remaining soils do not exceed the Soil Screening Levels specified in Table I and do not present an unacceptable direct contact risk (calculated cancer risk level greater than 1E-04 or hazard index greater than 1) for the future resident child scenario. Following excavation, confirmation soil samples will be collected and analyzed from the excavation areas to insure that the remaining

soils do not exceed these levels. Confirmation sampling will be conducted in accordance with a sampling plan to be approved by EPA during the Remedial Design.

The remaining building foundation slabs will be removed, crushed or broken for consolidation into the Quarries. Soils beneath the building slabs or other structures that precluded earlier investigation will be sampled and evaluated for contamination. The existing wastewater Equalization Basin will be drained and demolished for consolidation into the Quarries. Each contaminated soil area determined to present unacceptable direct contact exposure risk or unacceptable groundwater contamination risk, as described in Section VII of this ROD, will be excavated for consolidation into the Quarries. Excavation of soils will continue until confirmation samples from these areas demonstrate that the remaining soils are at levels protective to future residents and groundwater. The surface of the main Property will be regraded as necessary to direct surface water away from the Quarries to reduce surface water accumulation.

The waste materials described above (i.e. soils, crushed building foundation material, etc) may be consolidated into either quarry, with the following restrictions. Prior to the addition of any additional consolidated waste materials into the South Quarry, the in-situ stabilization of the South Quarry waste must be completed. Prior to the addition of any additional consolidated waste materials into the North Quarry, a layer of clean fill will be placed in the bottom of the quarry to a thickness necessary to minimize the potential for groundwater to contact the consolidated waste. The appropriate thickness of clean fill will be determined during the Remedial Design phase, but it is anticipated to be approximately 10 to 15 feet.

It is currently expected that all contaminated soils, building foundations and debris from the Property will be consolidated in the Quarries. However, subject to EPA approval any materials uncovered during demolition, excavation or consolidation activities, that are determined to be more appropriate for off-site disposal may be taken off-site for disposal at an appropriately permitted disposal facility. Any excavated materials that are identified for off-site disposal would be sampled for waste classification prior to off-site disposal. Arrangements for excavation, transportation and disposal of these materials will be in accordance with all appropriate disposal regulations. Materials that are highly toxic or highly mobile, such as liquid contaminants or other contaminated materials that could not be reliably contained on-site may be considered more appropriate for off-site disposal. It is anticipated that the volume of any such material would be small, and unlikely to significantly increase the scope of operations or cost of the remedy.

4. **Capping of the North and South Quarry**

The North and South Quarry, with the additional consolidated waste materials, shall be backfilled with clean fill, graded and capped at the level of the surrounding ground surface elevation to promote proper drainage away from the Quarries. Multiple-layer caps are placed on waste to prevent direct contact and to minimize or eliminate infiltration of water into and through the waste. Layers may include geosynthetic membranes or liners, compacted soils, clays and other structural and functional materials typically used for capping.

The waste in the Quarries most resembles the definitions for Residual Waste, therefore the caps would be designed to comply with the performance requirements of Pennsylvania's regulations for a Residual Waste Landfill.

It is anticipated that capping of the Quarries will virtually eliminate infiltration of precipitation. Therefore, a stormwater management plan that will address increased runoff, potential erosion, and adverse impacts to adjacent properties will be required during the Remedial Design.

5. **Long-Term Monitoring of Groundwater**

Long-term monitoring of contaminants shall be conducted throughout the extent of the groundwater plume to determine if the above source control measures are effective in reducing contaminant concentrations in groundwater to drinking water standards. The results of groundwater monitoring will also be evaluated to determine the potential for vapor intrusion impacts to buildings located above the contaminated groundwater plume. Representative monitoring wells on the Property, downgradient residential wells that are impacted or potentially impacted, and surface water locations on East Valley Creek will be monitored. The specific wells and sampling locations, as well as the frequency of sampling will be submitted to EPA for review and approval in the form of a Long-Term Monitoring Plan during the Remedial Design phase. The selected wells and surface water locations will be analyzed for representative contaminants starting with the contaminants listed in Table III above, however, subject to EPA approval, the list of chemicals may be revised during the development and implementation of the monitoring plan to a smaller list of indicator contaminants that can adequately represent groundwater quality and cleanup goals at this Site.

To ensure that information developed by the monitoring program will be representative of the changing groundwater conditions, the available downgradient wells will be evaluated and additional constructed monitoring wells are expected to be required to fill in data gaps. It is anticipated that at least two new monitoring wells will be installed in appropriate downgradient locations to further characterize the plume area. For cost estimation purposes, the Feasibility Study contemplated eight residential wells to be sampled annually for lithium, boron and chromium, and nine facility wells to be sampled annually for lithium, boron and chromium as well as a number of other representative contaminants. Initially, however, sampling will be more frequent (semi-annually or quarterly) to establish a baseline. The downgradient sampling may be reduced or discontinued as the levels of contaminants diminish over time.

At the First Five Year Review, EPA will evaluate the monitoring data to determine the effectiveness of the source control components of the remedy and whether the cleanup of groundwater throughout the entire plume is likely to occur in a reasonable timeframe. If restoration of the aquifer is unlikely to occur, a Focused Feasibility Study may be required to determine if alternative remedial action is necessary for the areas of the plume where cleanup levels will not be achieved in a reasonable timeframe.

6) **Removal of LNAPL from groundwater in the vicinity of MW-2**

The free-product LNAPL observed in Monitoring Well MW-2 during the Remedial Investigation

will be removed with a passive recovery device or oil-absorbent boom placed within the well. The recovered material will be analyzed and disposed offsite in accordance with the regulations determined to be appropriate to the results of the analysis. When recovery becomes impractical (i.e., low recovery efficiency), an oxygen release compound shall be utilized to enhance biodegradation of any residual petroleum contamination in this area.

7) **Institutional controls**

Institutional controls shall be implemented to insure the following activities:

1) Future residential development is prohibited on the capped areas of the North and South Quarry;

2) Notification to current and future owners of the Property regarding the impacted groundwater, soil contamination and quarry fill left at the conclusion of remedial action;

3) Any activity that could potentially damage or interfere with the selected remedy shall be prohibited;

4) An Institutional Control in the form of a Groundwater Management Zone shall be implemented for the downgradient areas impacted or potentially impacted by contaminated groundwater. The extent of the Groundwater Management Zone is currently anticipated to include areas directly adjacent to the geologic contact fault and within the general bounds of the area of concern depicted in Figure 3, however the specific geographic extent will be developed in consultation with the Pennsylvania Department of Environmental Resources, the Chester County Health Department, and East Whiteland Township to minimize the potential for exposure to contaminated groundwater. This may entail restrictions on installation of new wells in the groundwater management zone, mandatory sampling for Site-related contaminants on new wells and other methods of identifying or limiting exposure. The extent and requirements for this zone are expected to be revised with time as contaminants are depleted and the extent of the plume shrinks.

Institutional controls may include deed notices, restrictive covenants, and/or other appropriate legal restrictions.

Five Year Reviews

Because waste will remain on-site, Five-year Reviews of the remedy will be conducted. Where a remedy allows waste to remain on-Site, such that the Site does not allow unrestricted use and unlimited access, reviews of the implemented remedy are to be conducted at least every five years pursuant to Section 121(c) of CERCLA, 42 U.S.C. 9621, to ensure that the remedy remains protective. If it is determined from the results of the Long-term Monitoring or Five-year Reviews that the remedy is no longer protective, additional response actions may be taken.

The components of the Selected Remedy presented here are specific to the current conditions of the Site. Because the intention of the current owner is to redevelop the Property for productive

use, components of the remedy for this Site may be modified in the design stage to facilitate such development.

Any such modification and site development work must be planned and conducted in a protective manner consistent with the selected remedy, or use approaches that will ultimately result in a corresponding level of protection whether the Site is developed for industrial, commercial or residential use. Any design component that would constitute a significant variation from the remedy may require a formal change to the ROD that would be subject to public comment prior to approval. Additionally, actual development of the Property is subject to all relevant local regulations, permit procedures, and standard and customarily required approvals.

Summary of the Estimated Remedy Costs

The cost totals for the three basic components that comprise of the Selected Remedy are listed below.

Containment by Consolidation and Capping of the Quarries at Surrounding Elevations

Capital Cost	$ 3,580,200
Present Worth O&M Cost	$ 433,420

In-Situ Soil Stabilization of the Waste in the South Quarry

Capital Cost	$ 9,238,000
Present Worth O&M Cost	$ 0

Excavation and Off-Site Disposal of the Radiologically-Impacted Soils

Capital Cost	$ 684,000
Present Worth O&M Cost	$ 0

Total Remedy Cost **$13,936,000** (rounded)

Expected Outcome of the Selected Remedy

By consolidating and containing the Site wastes and contaminated soils under constructed caps to be installed on the North and South Quarries, the Selected Remedy will reduce to acceptable levels the direct contact risks to human health presented by the Foote Mineral Site. Additionally, radiologically contaminated soils will be removed from the Property and disposed off-site. This will reduce or eliminate the risk of exposure to above-background radiation. Removing the radiologically-contaminated soils and consolidating and capping the wastes and contaminated soils in the Quarries, will allow the non-quarry areas of the Property to be redeveloped.

By consolidating the soils that could continue to impact the groundwater in the Quarries and then capping the Quarries, the potential for contaminant migration caused by infiltration of surface water will be virtually eliminated. Lateral migration of contaminants from the South Quarry waste that is in contact with the groundwater will be mitigated by the in-situ Soil Stabilization technology. Together, consolidation, capping and stabilization will minimize the continued

migration of contaminants to the groundwater allowing the existing contamination plume to dissipate.

Groundwater modeling conducted by ERM indicated that the existing groundwater plume of contamination will recede to the Property line within 15 years of capping the Quarries. The USGS evaluation of the model, however, suggests that it will take significantly longer to reach cleanup levels. At the current time there are no residential wells being used for drinking water in the downgradient contaminant plume area. As a requirement of this ROD Institutional controls in the groundwater area of concern as depicted on Figure 3 will be implemented to prohibit the installation of new drinking wells until groundwater cleanup levels have been attained.

XIII. STATUTORY DETERMINATIONS

Under CERCLA, selected remedies must protect human health and the environment, comply with ARARs, be cost effective, and use permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Additionally, CERCLA, includes a preference for remedies that use treatment to significantly and permanently reduce the volume, toxicity, or mobility of hazardous wastes, as their principal element. The following sections discuss how the Selected Remedy meets these statutory requirements.

Protection of Human Health and the Environment

The Selected Remedy will provide protection of human health and the environment by minimizing the risk of direct exposure to Site-relate contamination. Contamination will be excavated, consolidated and contained under constructed caps with long-term operation and maintenance provisions. Radiologically contaminated soils will be removed from the Property and disposed off-site in appropriately permitted facilities. This will reduce or eliminate the risk of exposure to above-background radiation.

In-situ Stabilization of the South Quarry wastes, along with the consolidation and capping of other Site wastes will minimize the continuing migration of contaminants to groundwater, and allow the Downgradient Contaminant Plume to dissipate.

The ERM model predicts cleanup in the groundwater to health based levels in a reasonable time frame for Area C. But in Area B the attainment of health-based levels is predicted to take hundreds of years, due to complex geologic conditions. However, the alternate interpretation of groundwater flow presented by USGS suggests that shorter cleanup times for Area B may be achieved. Therefore, long-term groundwater monitoring is required as part of the Remedy to determine the effectiveness of the source control components on the cleanup of the groundwater throughout the entire plume. EPA will use this data to reduce the uncertainty of the modeling predictions. At the first Five Year Review, EPA will evaluate the monitoring data and updated modeling predictions to determine if groundwater restoration throughout the plume is likely to occur in a reasonable timeframe. If restoration of the aquifer is unlikely to occur, a Focused Feasibility Study may be required to determine if alternative remedial action is necessary for the areas of the plume where cleanup levels will not be achieved in a reasonable timeframe.

Until acceptable levels are reached in groundwater, institutional controls will prohibit the use of contaminated groundwater.

Compliance with Applicable or Relevant and Appropriate Requirements

The selected remedy will attain all applicable or relevant and appropriate chemical-specific, location-specific and action-specific ARARs as specified and described in Table VI.

Cost Effectiveness

Section 300.430(f)(1)(ii)(D) of the NCP, 40 C.F.R. § 300.430(f)(1)(ii)(D), requires EPA to evaluate cost-effectiveness by comparing all the alternatives meeting the threshold criteria - protection of human health and the environment and compliance with ARARs - against long-term effectiveness and permanence; reduction of toxicity, mobility or volume through treatment; and short-term effectiveness (collectively referred to as "overall effectiveness"). The NCP further states that overall effectiveness is then compared to cost to ensure that the remedy is cost effective and that a remedy is cost effective if its costs are proportional to its overall effectiveness.

EPA concludes, following an evaluation of these criteria, that the Selected Remedy is cost effective in providing overall protection in proportion to costs and meets all other requirements of CERCLA. The estimated present worth value of the Selected Remedy is $13,936,000.

Utilization of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable

The selected remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable through the use of In-situ Soil Stabilization. In-situ Soil Stabilization is a technology that uses mixes cement and other appropriate additives to turn high permeability fine grained materials with large total surface area into relatively impermeable monolithic masses. This treatment technology permanently immobilizes contamination within the treated mass.

Preference for Treatment as a Principal Element

The Selected Remedy satisfies the statutory preference for treatment as a principal element. The remedy includes treatment by In-situ Soil Stabilization of a significant portion of the source material in the South Quarry.

Five Year Review Requirements

Because the remedy will result in hazardous substances remaining on-site above levels that will allow for unlimited use and unrestricted exposure, a review will be conducted at least every five years after initiation of the remedial action pursuant to CERCLA Section 121(c) and the NCP Part 300.430(f)(5)(iii)(C).

Documentation of Significant Changes

The Proposed Remedial Action Plan issued on October 12, 2005 indicated that all non-radiologically contaminated materials would be consolidated and disposed on-site. Although it is still anticipated that the on-site waste will be consolidated and disposed in the Quarries, the Selected Remedy was expanded to allow off-site disposal for small volume wastes if determined to be appropriate.

EPA's Proposed Plan stated that any cap for the Quarries will be designed to comply with the performance requirements of Pennsylvania's regulations for a Residual Waste Landfill. Following issuance of the Proposed Remedial Action Plan, PADEP indicated that the asphaltic cap described in Alternative 2a/2b would not meet the requirements of Pennsylvania's Residual Waste Regulations. Consequently EPA has selected Alternative 2b, Engineered Geosynthetic Caps, as the capping component for the Selected Remedy.

During demolition, excavation or consolidation activities, soils beneath the building slabs or other structures that precluded earlier investigation will be sampled and evaluated for contamination. If the soils are contaminated above the levels described for direct contact risk soils or groundwater risk soils they will be consolidated into the Quarries or, if appropriate, characterized and transported to an appropriate facility for off-site disposal.

Additionally, the Selected Remedy was modified from the Proposed Remedial Action Plan to require a layer of clean fill to be placed in the bottom of the North Quarry before any site waste is consolidated into the North Quarry. The thickness of this layer will be designed to minimize the potential for groundwater to contact the consolidated waste, and will be specified in the Remedial Design phase. It is currently expected to be at least 10 to 15 feet. This requirement would not add significant cost or complexity to the remedy because the addition of fill material is necessary to bring the level of the quarry fill to the level of the surrounding elevation.

This ROD specifies that following the first Five-Year Review, if it is determined that groundwater restoration throughout the plume is unlikely to occur in a reasonable timeframe, a Focused Feasibility Study may be required to determine if alternative remedial action is necessary. This was not discussed in the Proposed Plan.

Table VI

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS) FOR THE FOOTE MINERAL CO. SUPERFUND SITE

ARAR	Legal Citation	Classification	Summary of Requirement	Further Detail Regarding ARARs in the Context of the Remedy
I. CHEMICAL SPECIFIC				
WATER				
Maximum Contaminant Levels (MCLs)	40 C.F.R. §§ 141.61-62 and 141.64	Relevant and Appropriate	MCLs are enforceable standards for public drinking water supply systems which have at least 15 service connections or are used by at least 25 persons. Although contaminated groundwater is not currently being used, a public water supply well (currently shut down) is located in the plume, and there is potential for future use.	The groundwater will meet the MCLs of these regulations for the specific contaminants listed with their MCLs in Table III.
Maximum Contaminant Level Goals (MCLGs)	40 C.F.R. §§ 141.50(b), 141.51(b) and 141.53	Relevant and Appropriate	MCLGs are non-enforceable health goals for public drinking water supplies which have at least 15 service connections or are used by 25 persons. Although contaminated groundwater is not currently being used, a public water supply well (currently shut down) is located in the plume, and there is potential for future use.	The groundwater will meet the non-zero MCLGs of these regulations for the specific contaminants listed with their MCLGs in Table III.
II. LOCATION SPECIFIC				
No Location Specific ARARs have been identified for this Site				
III. ACTION SPECIFIC				
WATER				
Water Well Drillers License Act	25 PA Code 47.1, 47.2	Applicable	Specifies the requirements for water well drillers in Pennsylvania.	Additional monitoring wells for this Site must be drilled in accordance with the substantive requirements of this act.
Well Abandonment	PADEP's Public Water Supply Manual, Part II, Section 3.3.5.11	Applicable	Regulations for abandoning old or unused wells	Unused wells are to be sealed in order to eliminate the possibility of wells acting as a conduit for contamination
Erosion and Sediment Control	25 PA Code 102.4(b), 102.11, 102.22	Applicable	Identifies erosion and sediment control requirements and criteria for activities involving land clearing, grading and other earth disturbances and establishes erosion and sediment control criteria.	The substantive provisions of these regulations apply to construction activities at the Site which disturb the ground surface, including clearing, grading, excavation and cap installation.

Table VI — APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS) FOR THE FOOTE MINERAL CO. SUPERFUND SITE

ARAR	Legal Citation	Classification	Summary of Requirement	Further Detail Regarding ARARs in the Context of the Remedy
AIR				
National Ambient Air Quality Standards	40 C.F.R. §§ 50.6 and 50.7	Applicable	Specifies maximum primary and secondary 24-hour and annual average ambient air quality standards for particulate matter.	Substantive requirements will be applicable if remedial activities generate fugitive dust emissions.
Fugitive Air Emissions	25 PA Code Chapter 123.1(a)(1), (2), (3), (4), (5), 123.1(c) and 123.2	Applicable	Prohibition of certain fugitive emissions	Substantive requirements will be applicable if remediation results in fugitive emissions from demolition of buildings, clearing of land and stockpiling of materials.
SOLID WASTE				
Residual Waste Landfill	25 PA Code 287.231(b)(1) and (2), 287.231(c)(2) and (3), 288.234(a) - (c) and (e) - (h), 288.237, 288.241, 288.242(a), (b)(1), (b)(3) and (c), 288.243 and 288.244	Relevant and Appropriate	Establishes minimum requirements for closure of residual waste landfills in the Commonwealth, including minimum cap specifications.	The specifications of the cap and closure operations shall, at a minimum, comply with the substantive requirements of Commonwealth of PA closure requirements.
HAZARDOUS WASTE				
Standards Applicable to Generators of Hazardous Waste -Identification and Listing of Hazardous Waste	25 PA Code Chapter 261a 40 CFR part 261	Applicable	Hazardous waste determination requirements applicable to generators who treat, store, or dispose of hazardous waste.	In the event that excavated soil or sediments, or other materials are determined to be hazardous waste, State regulations would apply for those regulations EPA has authorized Pennsylvania to administer pursuant to 40 C.F.R. Part 271
Standards for Owners and Operators of Hazardous Waste TSDs	25 PA Code 264a.173	Relevant and Appropriate	Establishes standards for storing hazardous waste on-site.	In the event that excavated soil or sediments, or other materials are determined to be hazardous waste, the material shall be stored in accordance with the substantive requirements of 25 Pa. Code 264a.173 concerning the manner of storage.

Table VI

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS) FOR THE FOOTE MINERAL CO. SUPERFUND SITE

ARAR	Legal Citation	Classification	Summary of Requirement	Further Detail Regarding ARARs in the Context of the Remedy
RESIDUAL WASTE				
Residual Waste Regulations	25 PA Code 299.101, 299.111, 299.112 (a), (c), and (d), 299.114, 299.115, 299.116, and 299.131	Applicable	Establishes the criteria for storing residual waste.	In the event the excavated soils or sediments or other materials are not considered hazardous waste, the substantive requirements for storage of residual waste apply.
Residual Waste Regulations	25 PA Code 299.101-.133 25 PA Code 299.211-215	Applicable	Establishes the criteria for storing residual waste.	In the event the excavated soils or sediments or other materials are not considered hazardous waste, the substantive requirements for storage and transportation of residual waste apply.

Table VII	TO BE CONSIDERED MATERIAL (TBCs) FOR THE FOOTE MINERAL CO. SUPERFUND SITE			
TBC	**Legal Citation**	**Classification**	**Summary of Requirement**	**Further Detail Regarding ARARs in the Context of the Remedy**
Integrated Risk Information System (IRIS)	EPA Office of Research and Development	To Be Considered	IRIS is an EPA data base containing up-to-date health risk and EPA regulatory information for numerous chemicals. IRIS is the preferred source of toxicity information as it contains only those reference doses (RfDs) and cancer slope factors that have been verified by the RfD or Carcinogen Risk Assessment Verification Endeavor Workgroups.	These non-enforceable toxicity values have been considered while developing site-specific cleanup standards for each remedial alternative.
Risk Assessment Guidance for Superfund - Volume 1 Human Health Manual Part A, December 1989	EPA Office of Emergency and Remedial Response - EPA/540/1-89/002	To be Considered	EPA guidance for calculating baseline human health risk and establishing risk-based performance standards for Superfund clean-ups. Section 7.4 sets forth method for identifying appropriate toxicity values for contaminants of concern.	Considered when establishing risk based cleanup standards.
Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination	EPA Office of Solid Waste and Emergency Response - OSWER No. 9200.4-18	To be Considered	EPA Guidance Memorandum for determining cleanup levels for radioactive contamination.	Considered when developing cleanup levels for the areas of radioactive contamination.
Chester County Health Department Regulations for water wells	Chester County Health Department Rules and Regulations Chapter 500	To be Considered	Regulations for abandoning old or unused wells	Unused wells are to be sealed in order to eliminate the possibility of wells acting as a conduit for contamination
Landscaping Guidance	Office of the Federal Executive; Guidance for Presidential Memorandum on Environmentally and Economically Beneficial LandscapePractices on Federal Landscaped Grounds	To Be Considered	Landscape Practices for Federal Grounds	Landscape Practices for Federal Grounds

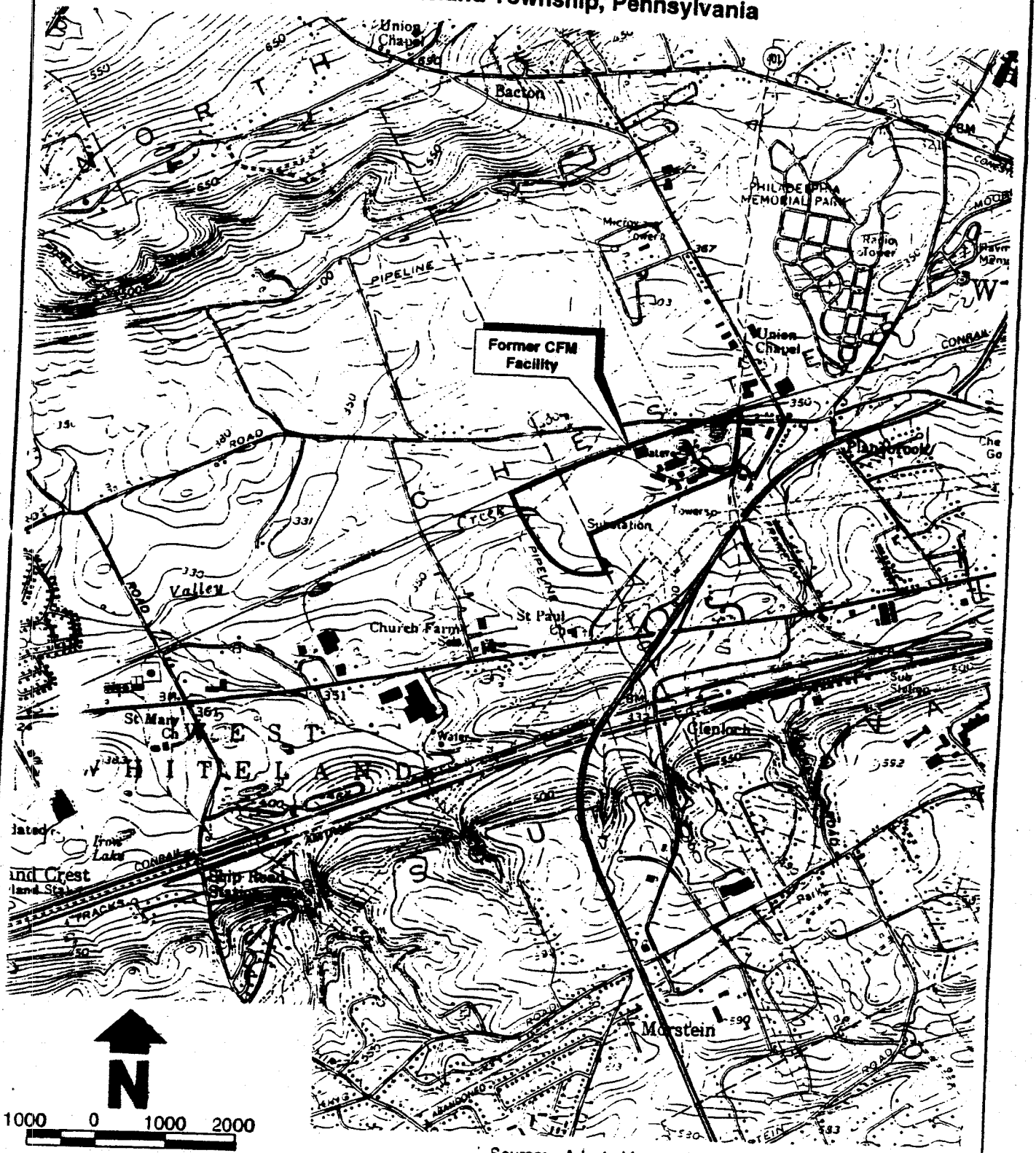
ADDITIONAL TABLE R-1

	Background Samples					Core Samples														ALL AREAS	
	BG-01	BG-07	BG-08	Max	Mean	AREA-01A	AREA-01B	AREA-01C	Max	Mean	AREA-02A	AREA-02B	AREA-02C	Max	Mean	AREA-03	AREA-04	AREA-05	AREA-06	Max	Mean
K-40	16.7	19.7	18.7	19.7	18.4	12.4	8.98	11.5	12.4	11	4.42	7.92	11.4	11.4	7.9	10.9	18.4	22.6	18.4	22.6	12.7
K-40 Error	2.49	2.88	2.76		4.7	2.34	2.39	2.72		4.31	1.11	1.68	2.18		2.97	2.26	3.15	3.22	2.69		7.75
Ra-226	4.19	3.54	4.49	4.49	4.07	52.4	128	111	128	97.1	26.4	32.8	35	35	31.4	32.1	98.3	4.87	6.59	128	52.7
Ra-226 Error	1.16	1.32	1.47		2.301	31.3	54.7	49.2		80	5.02	6.34	6.94		10.7	6.39	17.9	1.64	6.87		83 17
Ra-228	1.68	1.56	1.82	1.82	1.69	11.1	26.6	25.8	26.6	21.2	12.9	24.1	41.5	41.5	26.2	39	12.2	2.34	1.43	41.5	19.7
Ra-228 Error	0.333	0.32	0.368		0.591	1.75	3.99	3.87		5.83	1.95	3.55	6.12		7.34	5.77	1.93	0.417	0.337		11.19
Tot Ra	2.86	2.88	3.29	3.29	3.01	42.4	81.3	75	81.3	66.2	17.9	30.4	48.4	48.4	32.3	45.4	30.1	4	8.3	81.3	38.3
Tot Ra Error	1.226	1.358	1.515		2.375	31.35	54.85	49.35		80.16	5.39	7.27	9.25		12.94	8.61	18	1.69	6.88		83.92
Th-228		1.4		1.4	1.4		13.3		13.3	13.3	6.79			6.79	6.79					13.3	10
Th-228 Error		0.499			0.499		2.93			2.93	1.63				1.63						3.35
Th-230		1.74		1.74	1.74		215		215	215	3.51			3.51	3.51					215	109.3
Th-230 Error		0.556			0.556		43.6			43.6	0.944				0.9						43.61
Th-232		1.1		1.1	1.1		12.3		12.3	12.3	5.53			5.53	5.53					12.3	8.9
Th-232 Error		0.412			0.412		2.72			2.72	1.36				1.36						3.04
Tot Th		4.24		4.24	4.24		240.6		240.6	240.6	15.8			15.83	15.83					240.6	128.2
Tot Th Error		0.853			0.853		43.78			43.78	2.32				2.32						43.84
U-234		1.16		1.16	1.16		61.2		61.2	61.2	2.23			2.23	2.23					61.2	31.7
U-234 Error		0.424			0.424		13.5			13.5	0.686				0.7						13.52
U-235		0.08		0.08	0.08		2.54		2.54	2.54	0.224			0.224	0.224					2.54	1.4
U-235 Error		0.112			0.112		0.959			0.959	0.183				0.183						0.98
U-238		1.03		1.03	1.03		61.1		61.1	61.1	2.17			2.17	2.17					61.1	31.6
U-238 Error		0.391			0.391		13.5			13.5	0.671				0.7						13.52
Tot U		2.27		2.27	2.27		125		125	125	4.62			4.6	4.6					124.8	64.7
Tot U Error		0.588			0.588		19.1			19.1	0.977				0.977						19.14

Table R-1
Soil Sample Results in picocuries/gram (pCi/g)
Foote Mineral Superfund Site

FIGURES

Figure 1
Site Location Map
Former Cyprus Foote Mineral Facility
East Whiteland Township, Pennsylvania

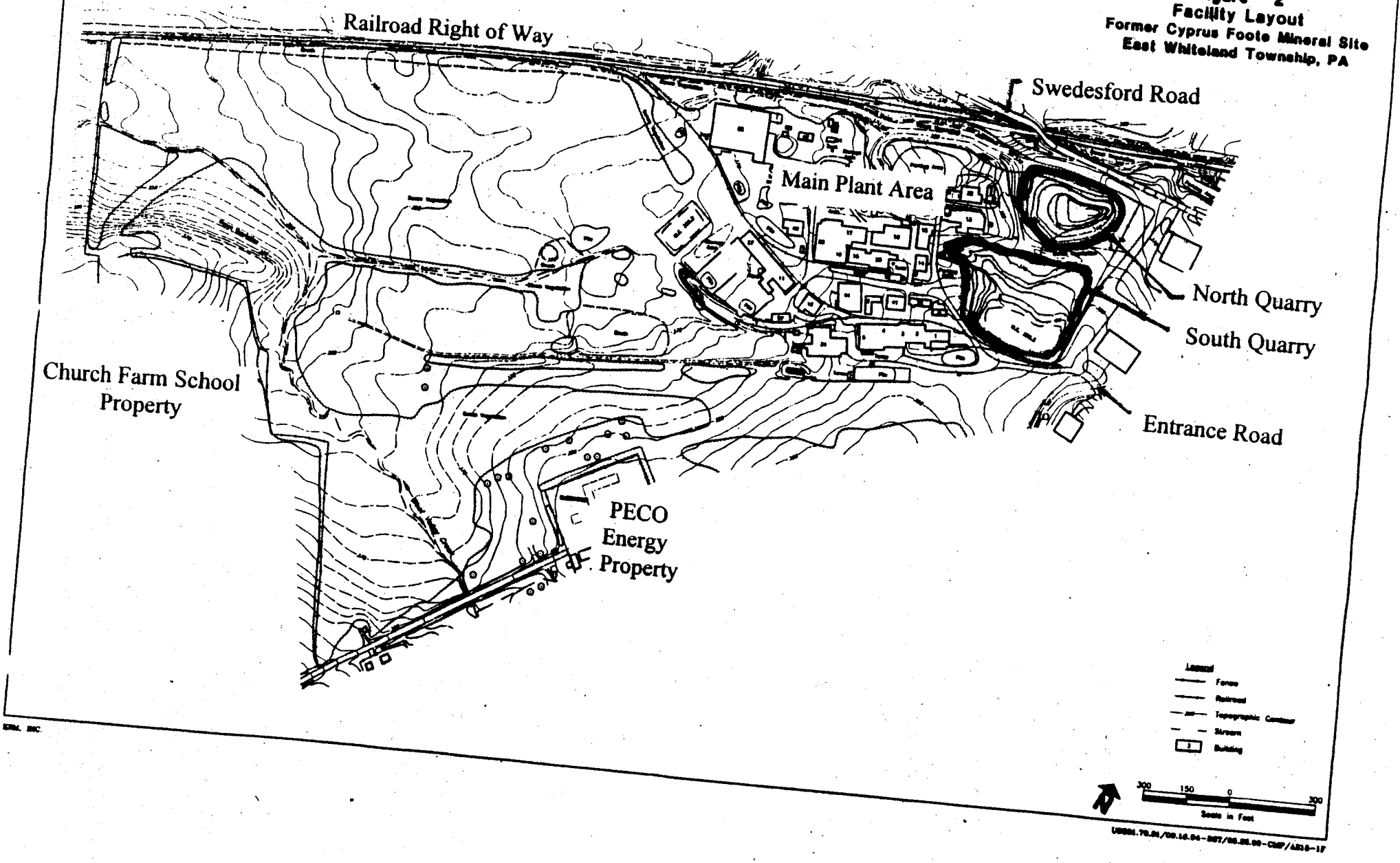


Source: Adapted from U.S.G.S. 7.5 Minute Series Topographic Maps, Malvern, PA (1983) Quadrangle

ERM

U9301.21 REV. EK/CE 7-26-00

Figure 2
Facility Layout
Former Cyprus Foote Mineral Site
East Whiteland Township, PA



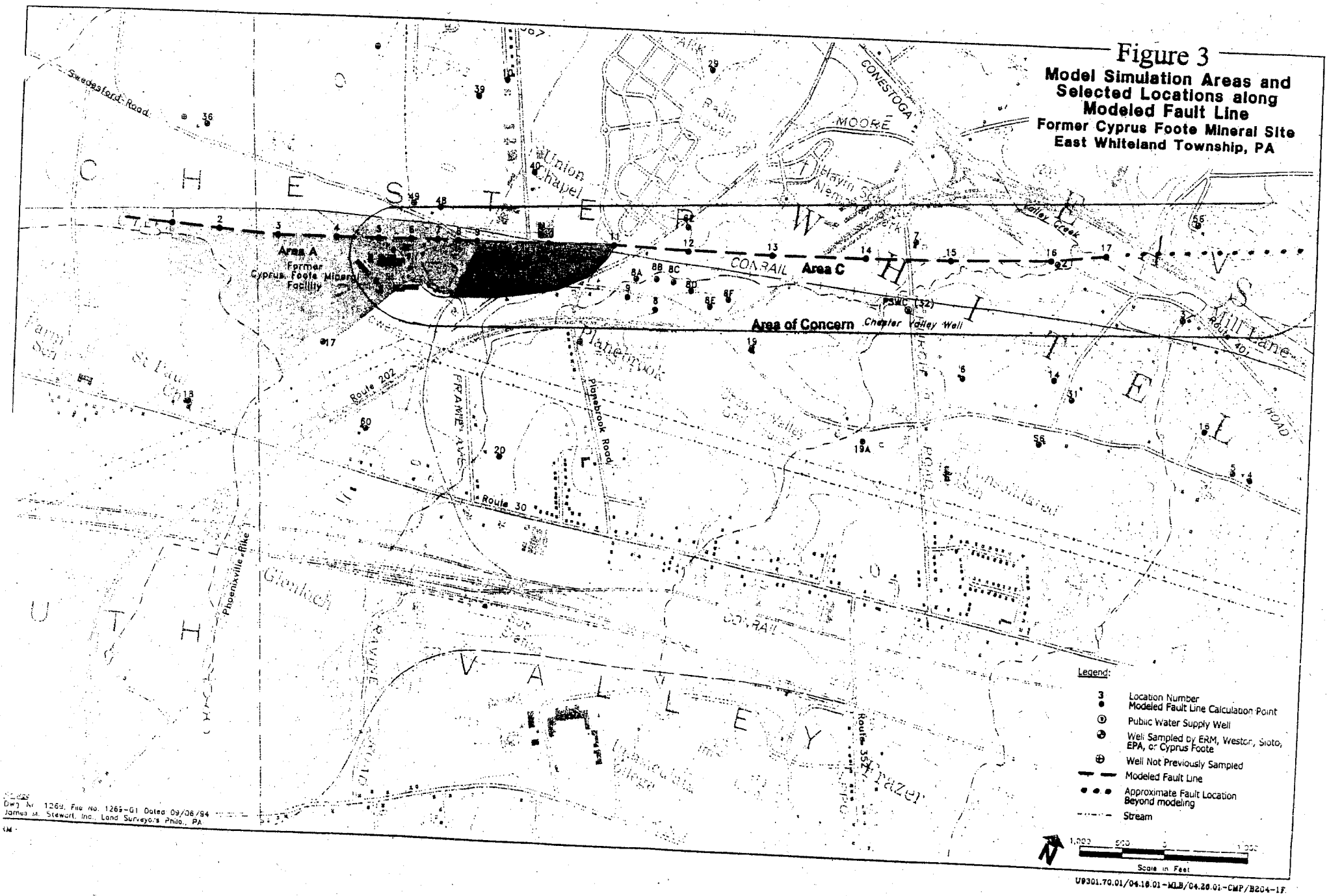
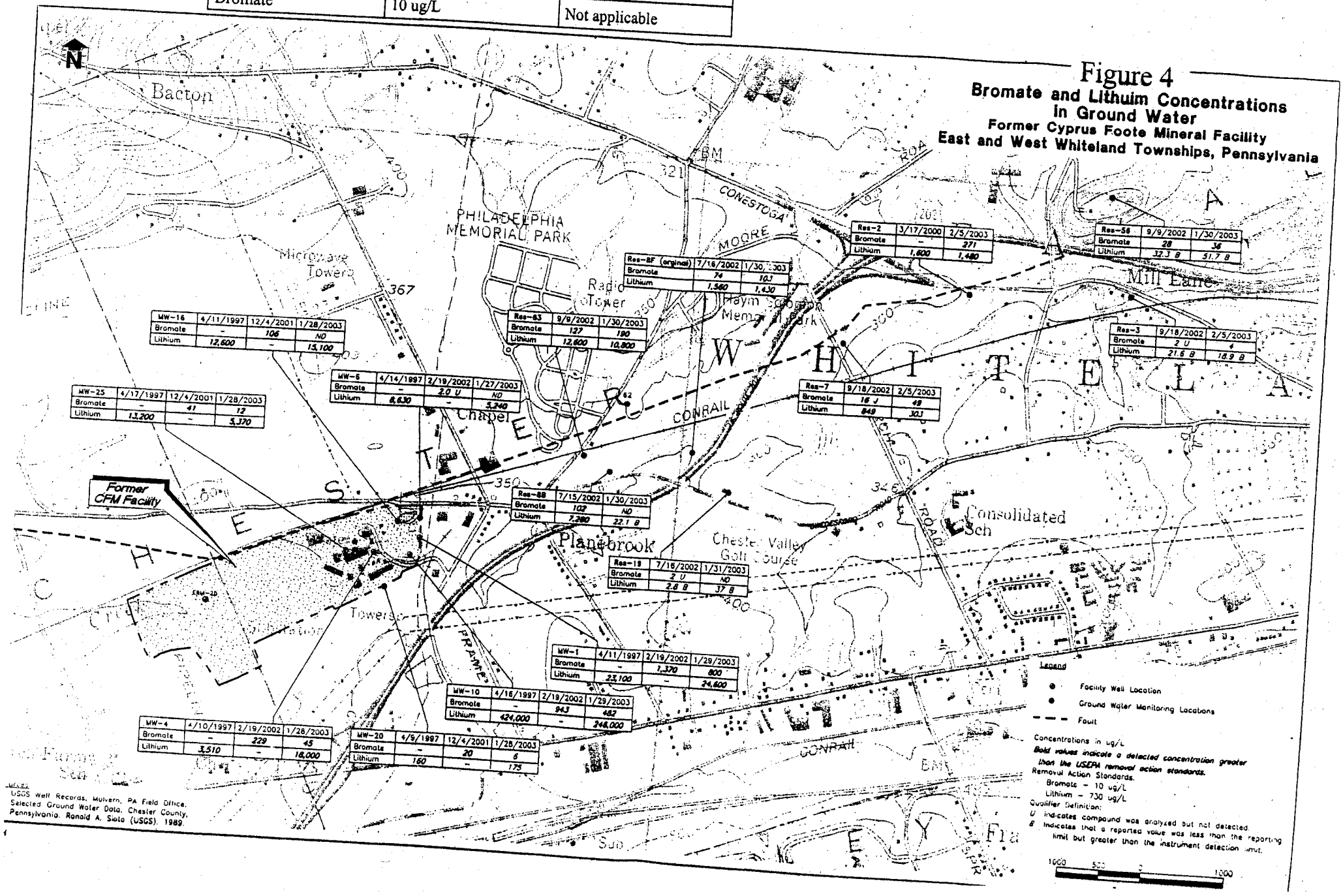


Figure 3
Model Simulation Areas and Selected Locations along Modeled Fault Line
Former Cyprus Foote Mineral Site
East Whiteland Township, PA
Area A
Former Cyprus Foote Mineral Facility
Area C
Area of Concern
Chester Valley Well
PSWC (32)
CONRAIL
Swedesford Road
Route 202
Route 30
Route 352
Planebrook Road
Phoenixville Pike
Valley Creek
Mill Lane
Legend:
Location Number
Modeled Fault Line Calculation Point
Public Water Supply Well
Well Sampled by ERM, Weston, Sloto, EPA, or Cyprus Foote
Well Not Previously Sampled
Modeled Fault Line
Approximate Fault Location Beyond modeling
Stream
Scale in Feet
Dwg. No. 1269, File No. 1269-G1 Dated 09/06/94
James M. Stewart, Inc., Land Surveyors Phila., PA
U9301.70.01/04.16.01-MLB/04.26.01-CMP/B204-1F

Contaminant	SDWA Maximum Contaminant Level	Region III Removal Guideline for drinking water
Lithium	Not applicable	730 ug/L
Bromate	10 ug/L	Not applicable



MW-16	4/11/1997	12/4/2001	1/28/2003
Bromate	-	106	ND
Lithium	12,600	-	15,100

MW-25	4/17/1997	12/4/2001	1/28/2003
Bromate	-	41	12
Lithium	13,200	-	5,370

MW-6	4/14/1997	2/19/2002	1/27/2003
Bromate	-	2.0 U	ND
Lithium	8,630	-	5,240

MW-4	4/10/1997	2/19/2002	1/28/2003
Bromate	-	229	45
Lithium	3,510	-	18,000

MW-20	4/9/1997	12/4/2001	1/28/2003
Bromate	-	20	6
Lithium	160	-	175

MW-10	4/16/1997	2/19/2002	1/29/2003
Bromate	-	943	482
Lithium	424,000	-	348,000

MW-1	4/11/1997	2/19/2002	1/29/2003
Bromate	-	1,370	800
Lithium	23,100	-	24,600

Res-88	7/15/2002	1/30/2003
Bromate	102	ND
Lithium	7,280	22.1 B

Res-19	7/16/2002	1/31/2003
Bromate	2 U	ND
Lithium	2.8 B	37 B

Res-83	9/9/2002	1/30/2003
Bromate	127	190
Lithium	12,600	10,900

Res-8F (original)	7/16/2002	1/30/2003
Bromate	74	103
Lithium	1,560	1,430

Res-2	3/17/2000	2/5/2003
Bromate	-	271
Lithium	1,600	1,480

Res-7	9/18/2002	2/5/2003
Bromate	18 J	49
Lithium	849	303

Res-56	9/9/2002	1/30/2003
Bromate	28	36
Lithium	32.3 B	51.7 B

Res-3	9/18/2002	2/5/2003
Bromate	2 U	4
Lithium	21.6 B	18.9 B

Figure 4
Bromate and Lithuim Concentrations in Ground Water
Former Cyprus Foote Mineral Facility
East and West Whiteland Townships, Pennsylvania

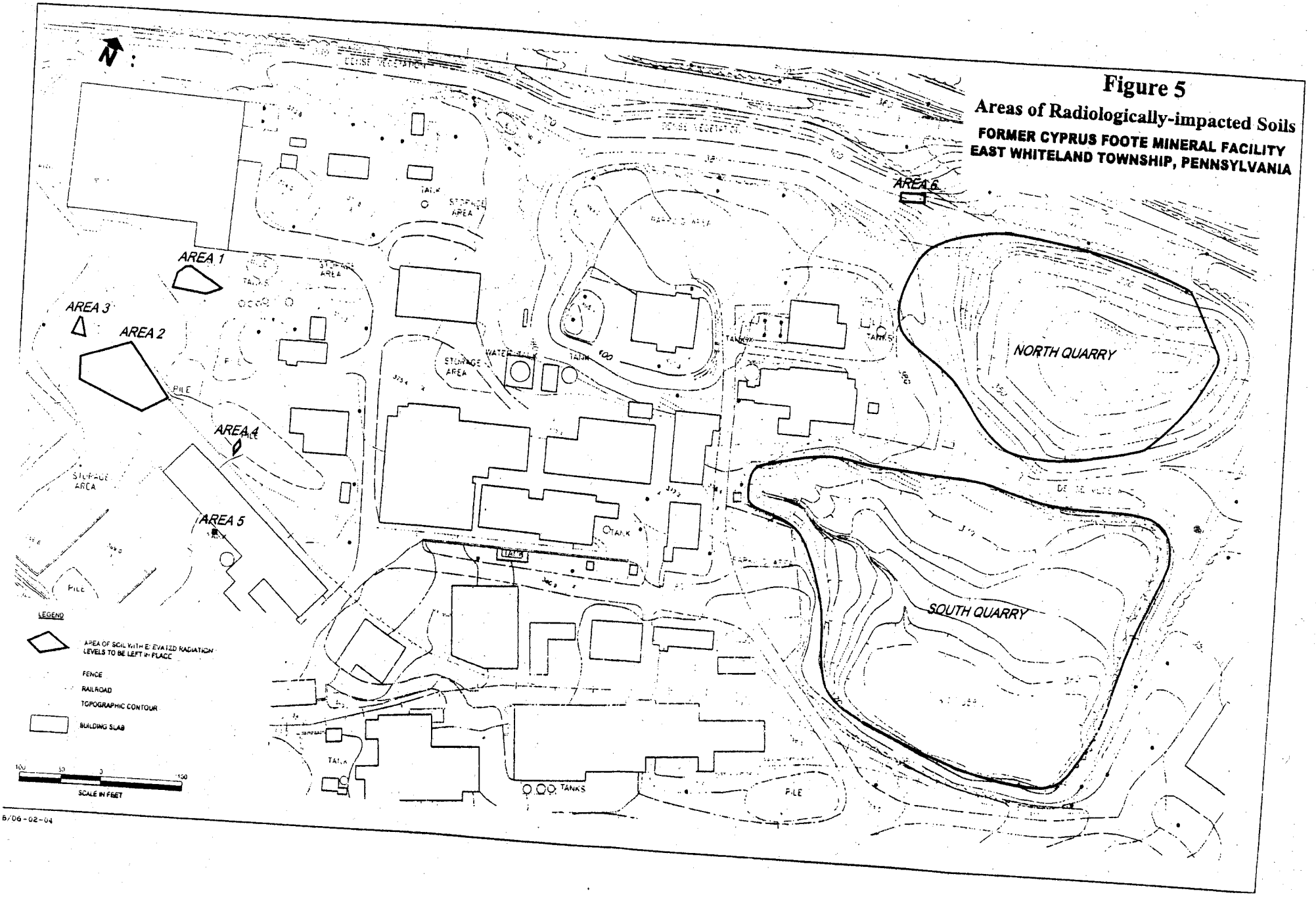


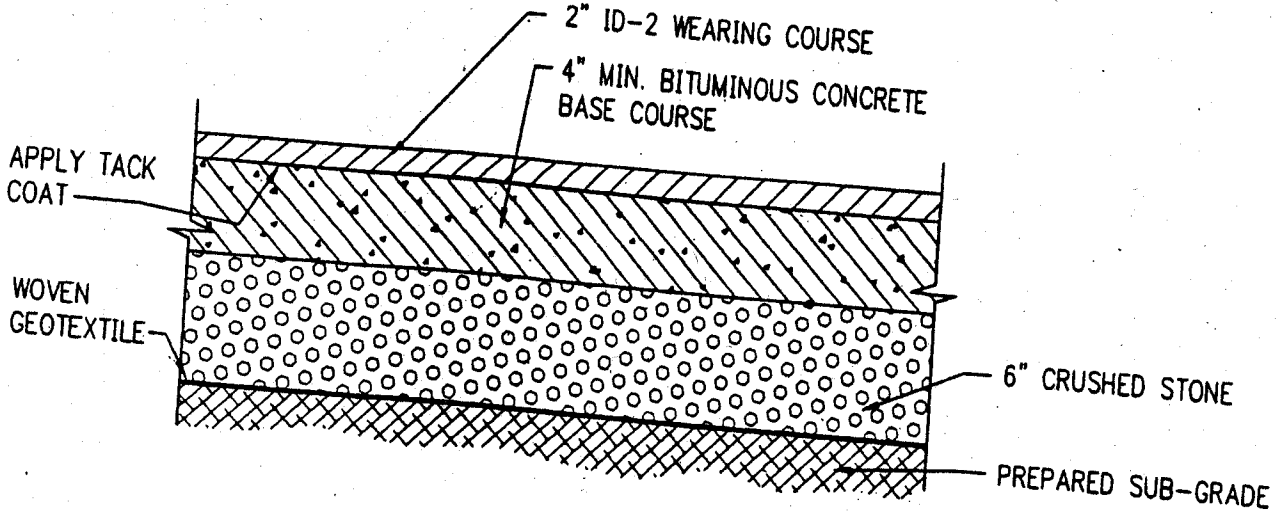
Figure 5

Areas of Radiologically-impacted Soils

FORMER CYPRUS FOOTE MINERAL FACILITY
EAST WHITELAND TOWNSHIP, PENNSYLVANIA

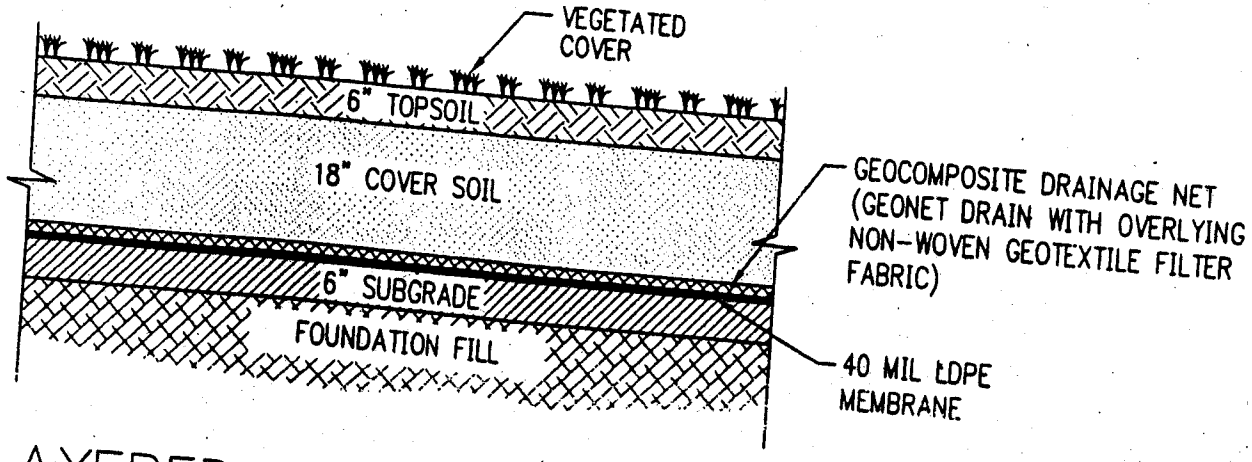
Figure 6

Conceptual Capping Details
Former Cyprus Foote Mineral Site
East Whiteland Township, PA



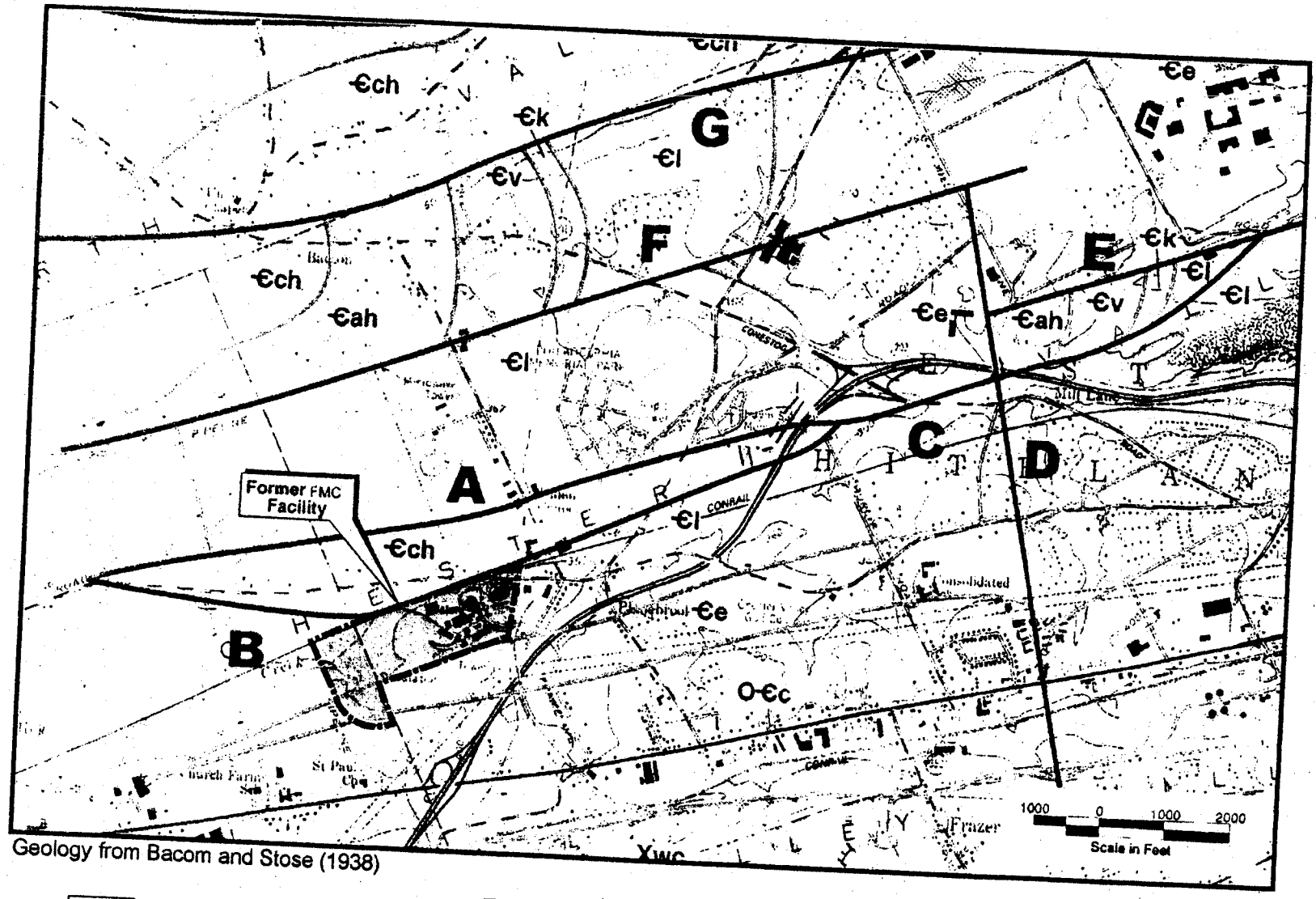
ASPHALT CAP

NOT TO SCALE



MULTILAYERED GEOSYNTHETIC/SOIL CAP

NOT TO SCALE



Geology from Bacom and Stose (1938)

O€c CONESTOGA LIMESTONE	€k KINZERS LIMESTONE	€ch CHICKIES QUARZITE
€e ELBROOK LIMESTONE	€v VINTAGE DOLOMITE	Xwc OCTORARO PHYLLITE
€l LEDGER DOLOMITE	€ah ANTIETAM AND HARPERS FORMATIONS	A GEOLOGIC CONTACT FAULT AND IDENTIFICATION LETTER

Figure 7. **Geologic map of the Foote Mineral Company Superfund Site and vicinity. Map modified from Environmental Resources Management, Inc. (2001a, figure 4-2).**

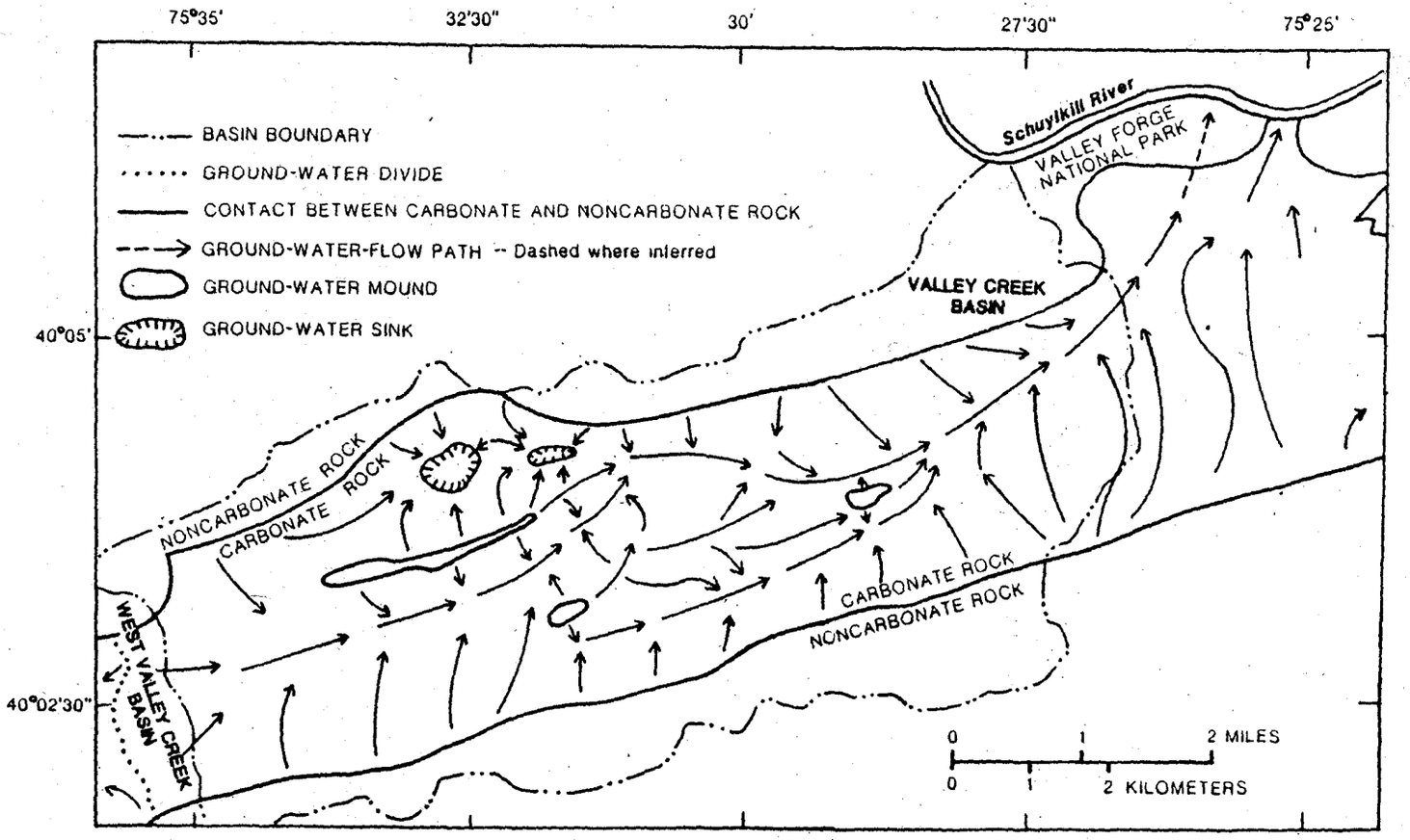
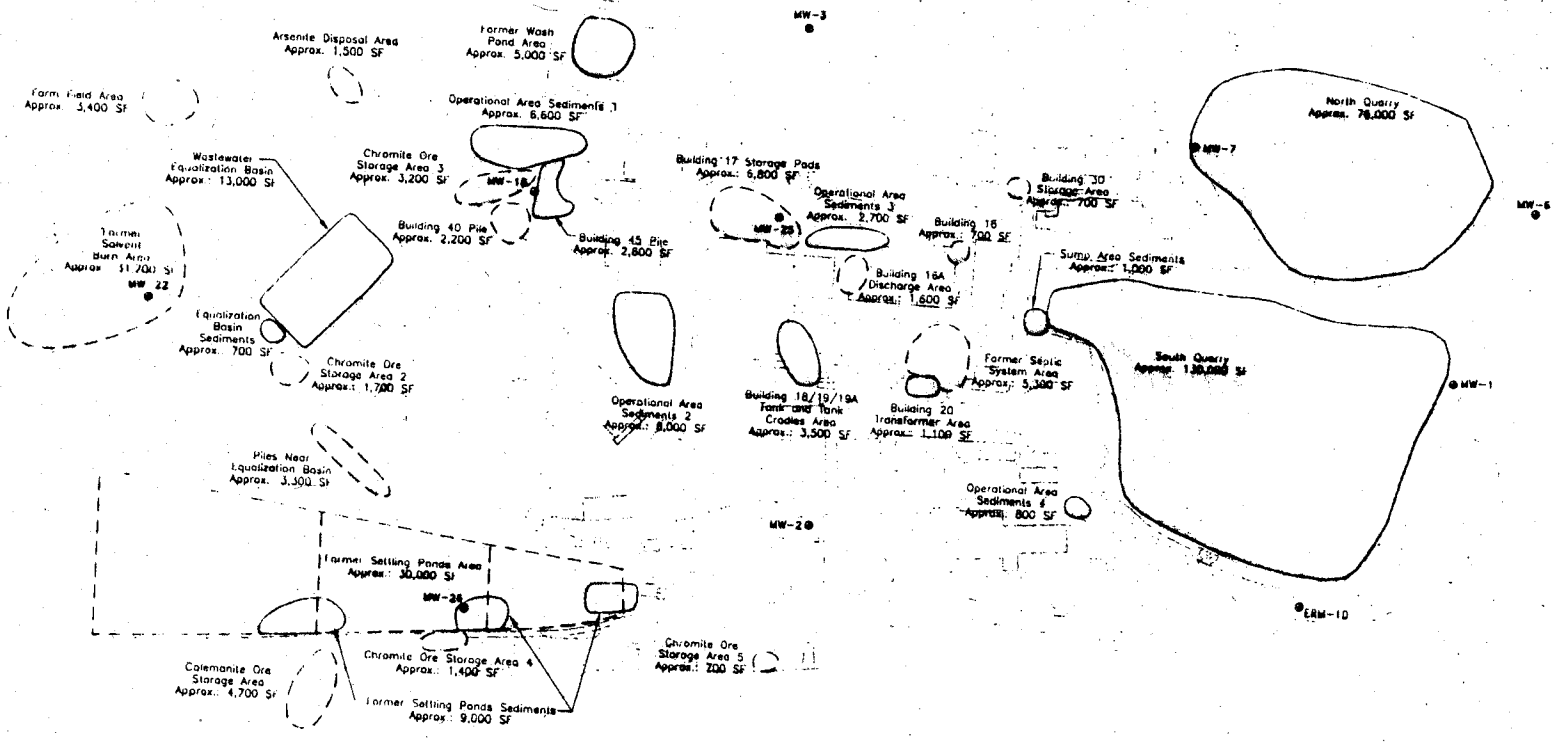


Figure 8. Generalized direction of ground-water flow in the carbonate rocks of Chester Valley. From Sloto (1990, p. 24).

Figure 9
Areas of Concern:
Direct Contact Risk, Groundwater risk



Area	Alternative 5	Volume (CY)
South Quarry	Excavate	177,000
North Quarry	Excavate	43,300
Areas of Potential Soil Exposure Concern	Excavate and Backfill	5,000
Potential Ground Water Source Areas	Excavate and Backfill	90,000
Wastewater Equalization Basin	Excavate and Backfill	1,500
MW-2 Area	Passive LNAPL Recovery	NA